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THE U. S. BATTLESHIPS "KENTUCKY" and "Kearsarge," launched at Newport News on March 24, were authorized by act of Congress of March 2, 1895, and the contract for their construction was awarded to the Newport News Ship Building & Dry Dock Co. on Jan. 2, 1896, for $2,250,000 for the hull and machinery of each ship. Both are officially rated as sea-going coast-line battleships of the first class with two military masts, and their dimensions, as given by the Bureau of Construction and Repair, are as follows: Length on load water line, 368 ft.; extreme beam, 72 ft. 2½ ins.; mean draft, 23 ft. 6 ins.; displacement, 11,525 tons; gross tonnage, 6,831 tons; net tonnage, 5,568 tons; twin screw, vertical triple expansion engines of an estimated maximum 10,000 I. HP.; normal coal supply, 410 tons, with 1,210 tons bunker capacity; contract speed, 16 knots. The main battery of each includes four 13-in. breech-loading rifles, four 8-in. breech-loading rifles, and fourteen 5-in. rapid-fire guns. The secondary battery of each includes 20 6-pdr. and six 1-pdr rapid-fire guns, four Colt guns and two field guns. Each is fitted with four Long-Whitehead torpedo tubes. The top side armor is from 16½ to 9½ ins. thick, with 13⅜ ins. at the water line; the 13-in. gun turrets are 17 and 15 ins. thick, and the 8-in. gun turrets 11 and 9 ins. thick; the barbettes are 15 and 12 ins. thick; the protective decks are 3 and 5 ins. thick on the slopes and 2⅜ ins. on the flat; 10,806 cu. ft. of corn-pith are used in the water-line protection. The complement of crew is 40 officers and 471 men for each ship, and the contract date of completion is Jan. 2, 1899. The two battleships are intended to be an improvement on all previous types of battleships in any navy in their proportion of armament to displacement. To "prevent the interference of fire" of the 8-in. with the 13-in. guns, as in the "Indiana" class of battleships, in the two new ships the 8-in. turrets are placed on top of the 13-in. turrets. As a consequence, these ships carry four instead of eight 8-in. guns, but supplement these by fourteen, instead of four 5-in. rapid-fire guns in broadside. The new arrangement gives the turning-gear and ammunition hoists of the 8-in. guns the protection of the turret for the 13-in. guns, and results in an economy in turning machinery. The "Kentucky" class can bring as many 8-in .guns to bear on a broadside as the "Indiana" class, and in addition can turn each pair through an unbroken arc of 270° ahead and astern. The effect of a crippling shot upon one of the two turrets, which might disable both, is the chief objection made against this innovation by naval experts.

THE JOHNSON CO., of Lorain, O., is about to add to its extensive steel converting and girder rail-making plant two large blast furnaces, with their necessary equipment, together with docks on Black River, and ore handling apparatus. A plant of 240 by-product coke ovens will also be erected. The necessary capital for this extension was secured in England after a favorable report on the works by Messrs. E. P. Martin and E. Windsor Richards, the eminent English steel-makers.

THE WIRE AND WIRE ROD CONSOLIDATION has taken place, but on a much smaller scale than was originally projected, several of the larger companies remaining outside. Incorporation papers were taken out in Illinois on March 21 for the American Steel & Wire Co., capital $24,000,000, half common and half preferred stock. The 14 plants included in the new company are the following: Consolidated Steel & Wire Co., seven plants, at St. Louis, Joliet, Cleveland, Beaver Falls, Pittsburg and Allentown; Salem Wire Nail Co., two plants, Salem, O., and Findlay, O.; H. P. Nail Co., Cleveland, O.; American Wire Co., Cleveland, O.; St. Elwood Co., two plants, De Kalb, Ill. The new company will purchase these properties and start business on April 3. It will have a producing capacity per year of from 700,000 to 800,000 tons of wire and wire rods, or about 75% of the total production of the United States. Among the wire concerns not included in the consolidation are: Washburn & Moen Mfg. Co., Worcester, Mass., and Waukegan, Ill.; New Castle Wire Nail Co., New Castle, Pa.; Oliver Wire Co., Pittsburg; Cleveland Rolling Mill Co., Cleveland; John A. Roebling's Sons Co. and Trenton Iron Co., Trenton, N. J.

THE GENERAL ELECTRIC CO. is enlarging its works at Schenectady, N. Y., to meet the growing demands for electrical apparatus. The present extension includes a new foundry and another machine shop. The former will be a brick building, 500 × 140 ft. with an "L" 100 × 120 ft., which will be used as a cleaning shop. Various and storage sheds and a large fireproof pattern storage building, 200 × 60 ft., will also be erected. This foundry will be modern in every particular and will add about 82,000 sq. ft. of covered floor to the already large plant. The increasing call for large apparatus, sometimes as large as 5,000 HP., demands further shop facilities, and plans are under consideration for a new machine shop to be 650 × 165 ft. The main aisle will be 65 ft. wide with narrow aisles at each side, all equipped with electric cranes. The heavy machine tools now located in the other buildings will be collected in this new shop, their places being filled with smaller apparatus. The total floor space of this building will be about 144,250 sq. ft.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred March 23 on the Louisville Division of the Pennsylvania R. R., about a mile south of Columbus, Ind. At this point a trestle gave way, precipitating a repair train into the swollen White River. Five men are reported killed and 19 others are missing.

A BLOCK SIGNAL INSTRUCTION EQUIPMENT is in use on the Cincinnati, New Orleans & Texas Pacific Ry., to instruct the employees in the handling of the signals described in our issue of March 10. The equipment includes a model of a length of track with two passing sidings, fitted with signals and two cars representing trains. This is fitted up in the air-brake instruction car, the equipment of which also includes a working model of the electric car lighting system, an electric headlight as used on some of the locomotives, and the sand jet appliance used for sanding the rails.

THE LAKE AND RAIL ROUTE of the Canada Atlantic Ry., noted in our issue of March 17, will not, we are officially informed, have any connection with the new direct railway line from New York to Ottawa. The Canada Atlantic Ry. has already an established route to New York, connecting with the Delaware & Hudson R. R. at Rouse's Point, while at Swanton, Vt., it has connections with the Central Vermont R. R. and Boston & Maine R. R.

THE CROW'S NEST PASS LINE of the Canadian Pacific Ry. was described in our issue of March 10, and in the company's annual report it is stated that the line will probably be completed to Kootenay Lake before the end of August, a temporary connection being then made with Nelson, 60 miles distant, by means of a train ferry. It is also stated that the maximum grades through the Rocky Mountains and the Selkirk range are only 1%, compensated for curvature, or barely half the rate of the maximum grades on any other railway crossing either of these ranges. The company will this year build about 100 miles west from the Columbia River at Robson, opening up the Boundary Creek mining district. The map accompanying the report shows a proposed extension of the Crow's Nest Pass line westward to Penticton, on Lake Okanagan, and thence to the Fraser River, connecting with the present main line at Hope, 89 miles west from Vancouver.

THE HARDIE AIR MOTOR is about to be tried on the street railways of Copenhagen, Denmark. The machinery for a motor car was taken from the United States and the car is being built in Copenhagen. The car will seat 24 persons inside and 24 on top. It will weigh 26,000 lbs. If it is successful, other cars weighing only 18,000 lbs. will be built.

THE PORT ARTHUR SHIP CANAL PROJECT is reported upon by Major James B. Quinn, Engineer Corps, U. S. A., under date of Feb. 2, 1898. Major Quinn reports that at the entrance to the proposed canal he found a cut 200 ft. long, 50 ft. and 12 ft. deep; no part of the canal is more than 16 ft. deep as yet; he finds the location of the canal dangerously near the lake and the works liable to erosion from wave action. He also reports danger from silting from the lake and from Taylor's Bayou, which the line crosses. The silt from this bayou, with a 2-mile or 4-mile current in the canal, would also endanger the deep waters of the pass at Sabine. The report was upon an application for an extension of dredging facilities made by the Port Arthur Channel & Dock Co. Major Quinn recommends that the bulkhead proposed be built without openings in it after Mud Bayou is reached; and that a complete barrier be maintained at this point until a satisfactory scheme for the disposal of the drainage system is proposed by the company and approved by the Secretary of War.

THE CORINTH SHIP CANAL, after being in operation four years, yields a total revenue of about $60,000; or, just enough to meet the working and administrative expenses. On the debt of $4,250,000 there is outstanding about $1,000,000 in unpaid interest. The one party benefited by the undertaking, in a financial way, is the French government, which annually receives $2,000 in taxes on the shares and bonds, for the right of negotiation in France.

THE PANAMA CANAL SHAREHOLDERS are waiting for the return of a technical commission sent out to Panama to report upon the state of the works and future prospects. This report is expected in about two months, and the shareholders will then decide whether the undertaking shall be finally abandoned or continued. The $13,000,000 with which the new company started out is nearly exhausted; and the canal has lost some of its attractions, as, if completed under the present contract, 60% of the net profits, after 5% is paid for interest and redemption of new capital, must be handed over to the liquidators of the old company. The $120,000,000 estimated as required to furnish the canal, will be difficult to raise under these circumstances, says the London "Economist."

MIAMI HARBOR, FLA., has been opened, in connection with the extension of the Florida East Coast Railway to Biscayne Bay, by a dredged channel to deep water, 7 miles long, 100 and 150 ft. wide and 12 ft. deep; the channel terminates in water 15 ft. deep. A railway and steamship pier has also been built, 775 ft. long and 400 ft. wide. This pier is constructed of tight bulkheads of creosoted timber, and the space within will be filled with sand and rock from shore. These bulkheads are sunk 26 ft. below the water surface, so that the basin can be deepened to 25 ft. whenever this is deemed advisable. Much of the channel was excavated in coral rock.

THE SOUTHWEST PASS, at the mouth of the Mississippi River, is being surveyed by a party under the charge of Mr. J. A. Ockerson, Chief Engineer of the Mississippi River Commission, and temporarily attached to the U. S. Engineers' district under the charge of Major James B. Quinn, Engineer Corps, U. S. A. This survey is the one ordered by Congress and will require several months' work.

MUNICIPAL OWNERSHIP OF ELECTRIC LIGHTING plants in England seems to be very popular at present. According to "The Surveyor," of London, 202 of 283 provisional orders for electric lighting plants issued in 1897 were granted to local authorities and only 81 to private companies. As we understand it, these provisional orders are mere authorizations to make loans or build works. "The Surveyor" has recently called attention to the popularization of electric lighting in England by means of penny-in-the-slot meters, and the installation of house wiring, lamps and lamp renewals without direct cost to the consumer. Wiring has been done by Free Wiring Syndicates, which receive "a sum ranging from ¼d. upwards" for "every unit" of electricity consumed on premises fitted up by the syndicates.

UNSAFE ILLUMINATING OIL is said to be on the market, in the report for January, 1898, of the Boston Manufacturers' Mutual Fire Insurance Co. A barrel of oil billed as 135° flash test was sampled and tested in a closed cup, and the results gave flash test 87°, fire test 107°. Another sample tested by the Massachusetts State Inspector in an open cup gave flash test 105°, fire test 125°. The Insurance Co. cautions its members against the use of the open cup oil tester, which gives results as much as 20° higher than those given by the closed cup. The caution concludes as follows:

> Members who may desire to test their own oils, a practice which is urgently commended to them, may procure the New York State Board of Health tester from Elmer & Amend, 205 Third Ave., New York, listed at $8. All the directions and information necessary for a ready investigation of burning and lubricating oils are given in a short handbook of oil analysis by Prof. Augustus H. Gill, of the Massachusetts Institute of Technology, published by J. B. Lippincott Co., Philadelphia.

AN ORDINANCE TO LIMIT THE HEIGHT OF BUILDings in Chicago to 130 ft. was passed by the city council on March 24. This means that in the future no building over 10 stories high will be permitted.

TWO RECENT SPECIAL MACHINE TOOLS FOR BRIDGE WORK.

The accompanying illustrations represent two interesting machine tools intended especially for the heaviest class of bridge work. These are built by Bement, Miles & Co., of Philadelphia, Pa., to whom we are indebted for photographs and particulars.

The double horizontal chord-boring machine, Fig. 1, has two separate and independent heads on one cast iron girder bed, which can be made of any desired length. The work is supported on the framing of each head, and securely clamped to the same. The boring spindles are 6 ins. diameter and have a traverse of 24 ins. by hand or power. They are driven by a cone 30 ins. diameter, with four changes for a 6-in. belt, the power being transmitted through a large spline shaft, supported by two movable brackets, which also act as rests for holding the work. Three automatic feeds are provided, and also rapid hand adjustment. The clamping surface on the heads is 36 ins. wide and 78 ins. long, provided with slots for clamping bolts. On these surfaces are sliding bearings, having revolving bushings supporting the outer ends of the boring bars.

While modifications can be made to suit requirements, these machines are generally built as follows: Greatest distance between centers of spindles, 50 ft.; center of spindles to top of clamping surface, 28 ins.; center of spindles to top of bed, 54 ins. One of the heads is stationary at one end of the bed; the other is moved by power along the bed, a graduated steel scale being fitted for accurately spacing the centers of the chords. The finished weight of this machine is about 50,000 lbs.

The double vertical bridge link drilling and boring machine, Fig. 2, consists of two complete, heavy and powerful boring machines of special construction, clamped in opposite or parallel positions, as preferred, upon a long cast-iron girder bed. Power is applied by a four-step cone, 30 ins. diameter, for a 6-in. belt, through a train of massive bevel gearing to the 6-in. spindles. These spindles have 24½ ins. vertical traverse, eight changes of speed, and three automatic feeds, with quick return movement and concentric counterbalance. Each machine is started and stopped independently of the other by positive clutches. The usual distance from center of spindle to inside of frame is 18 ins., which can be increased if desired. The least distance between the centers of the two spindles is 32 ins. The clamping tables are 32 ins. square, and have holes through their centers to act as steps for the boring bars. One of the machines is stationary on the bed, and the other can be moved along to suit the various lengths of work. Two rests are usually provided, supporting the work in the middle to prevent sagging. The usual length of bed permits of 50 ft. between centers, and the weight when so built is about 36,000 lbs.

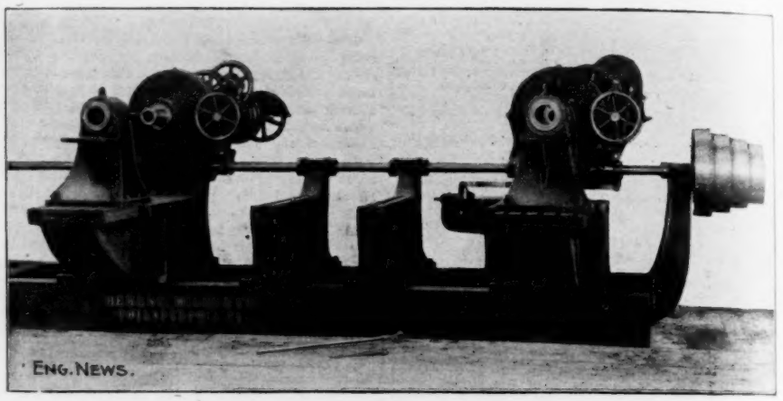


FIG. 1.—DOUBLE HORIZONTAL BORING MACHINE FOR BORING PIN HOLES IN BRIDGE COMPRESSION MEMBERS.
Bement, Miles & Co., Makers.

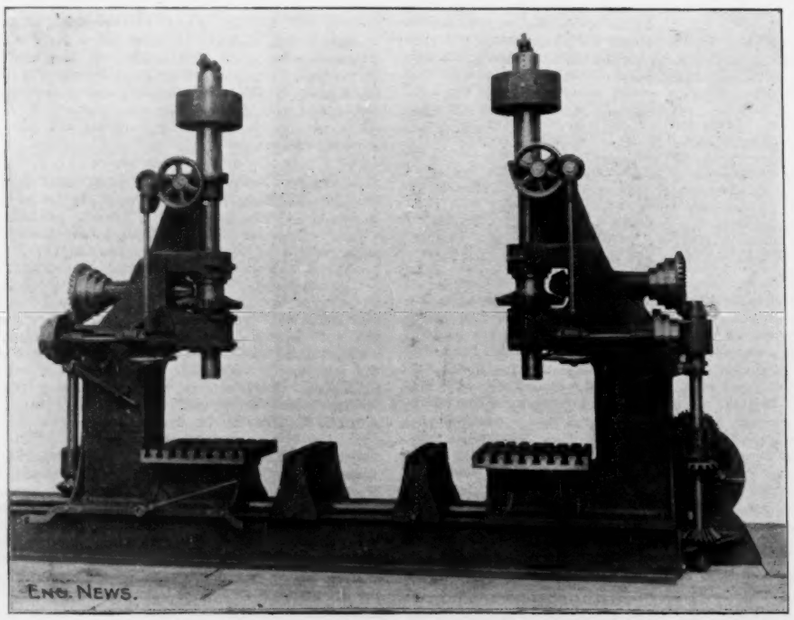


FIG. 2.—DOUBLE DRILLING MACHINE FOR BRIDGE EYE-BARS.
Bement, Miles & Co., Makers.

THE DECAYING COMMERCE OF NEW YORK AND HOW TO RESTORE IT.

By Thomas C. Clarke, Past-President Am. Soc. C.E.

The merchants of New York and all who are interested in the prosperity of that city, are beginning to wake up to the necessity of doing something to arrest the present falling off in her foreign commerce. It is quite time to do something. The Canadian Government, after many years' labor, expects to finish the enlargement of the last of the small St. Lawrence canals by the end of this year. This will give 14 ft. of water between Lake Erie and Montreal, enabling tows of barges of 2,700 tons burden to pass through from the upper lake ports to the sea.

The writer has prepared the accompanying table, giving the cost of carrying a bushel of wheat from Chicago, Duluth or Ft. William to Liverpool, by way of New York and by Montreal, by existing routes and by others proposed. In computing this table, he has followed the methods of calculation of Maj. T. W. Symons, U. S. Engineer, in his masterly report to Congress in 1897.*

It will be seen by this table that by the St. Lawrence route via Montreal, wheat can be carried for 2.81 cts. per bushel less than by New York through the present Erie Canal; for 1.73 cts. per bushel less than by the Erie Canal deepened to 9 ft.; and for 1.10 cts. per bushel less than by the Erie Canal if deepened to 11 ft. for 1,500-ton barges, as proposed by Maj. Symons.

This is not all. If the Dominion of Canada decides to give a sufficient subsidy, the Ottawa route will also be improved, a greater reduction of cost can be gained, and the New York route will be in a still worse position. The writer knows this to be true, as he has investigated the merits of the Ottawa route, and reported upon it. What should be done to meet this competition? Congress has been asked to vote an appropriation to make surveys and estimates of the cost of deepening the Erie Canal to 11 ft. for 1,500-ton barges, as suggested by Maj. Symons. This is all right, so far as it goes, but even that canal could not compete with the Canadian routes. Further surveys should be made to ascertain the cost of a 1,500-ton barge canal from the head of Lake Erie through the southern part of the peninsula of Michigan, or the northern part of Indiana, to Lake Michigan.

This would be an extension of the Erie Canal route, which would save over 400 miles of navigation between Lake Erie and Chicago, too dangerous for 1,500-ton barges to navigate safely. They could be towed through Lake Erie and across Lake Michigan as steel barges of less size and draft are now towed between New York and Cleveland.

Such a canal would save the present large transfer charges at Buffalo, which, as will be seen from the table herewith, are greater than the cost of carrying grain from Buffalo to Chicago if the proposed Michigan canal were built. The cost of such a canal can only be determined after careful surveys, but as there are no high ranges of hills to be crossed it is believed to be practicable.

The second suggestion is for a survey of an extension of the Ottawa route through Lake Champlain and the upper Hudson to New York. As will be seen from the table this route will be more expensive than the Erie-Michigan route from Chicago to New York, but an inspection of the accompanying map will show that the Erie-Michigan route alone would not accommodate the Lake Superior ports nearly as well as the Ottawa-Champlain route would do, as it would involve a much longer distance.

The great value of both of these suggested routes is, that for the greater part of the way they are a protected navigation consisting chiefly of rivers and canals, where tows of barges can make good time, and where there is little danger from storms.

*Eng. News, Nov. 11, 1897.

The distance from Chicago to New York by the Erie-Michigan route would be:

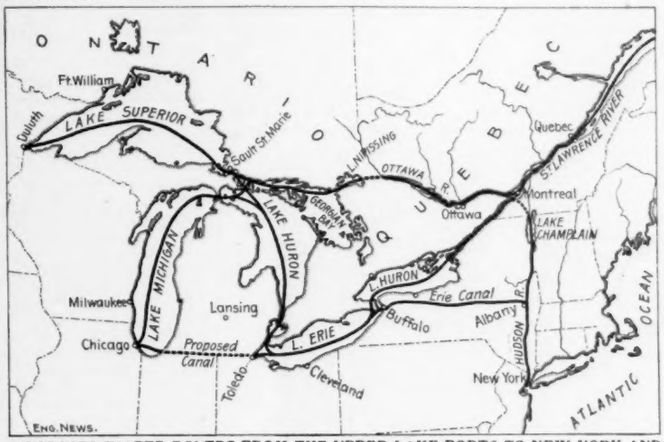
Open lakes	320	miles
Protected rivers	143	"
Navigation canals	530	"
Total	993	"

The distance from Chicago, Duluth or Ft. William to New York by the Champlain-Ottawa route would be:

Open lakes	380	miles
Protected rivers	847	"
Navigation canals	126	"
Total	1,353	"
To Montreal by the Ottawa route	970	"

By the Erie-Michigan route a tug-boat and three 1,500-ton barges could make seven round trips per season. On the Ottawa-Champlain route a tug-boat and three 3,100-ton barges could make eight trips per season. The size of the locks of the latter route would be 300 ft. long by 45 ft. wide, with 14 ft. depth of water.

In comparing the cost of transportation by different routes, it is necessary to make some uniform assumption of the amount of cargoes carried, and Maj. Symons has assumed in his report that barges will carry full cargoes going east and one-third full going west. My table has been calculated on the same basis, and Maj. Symons' estimates of cost have been followed for the routes numbered 2, 3 and 4. It must be clearly understood that the actual charges would not be as low as the figures given; but as equal additions must be made to all of them to provide for barges not averaging full cargoes, for shortages, and other contingencies of trade, the comparison becomes a fair one. Ten per cent. profit has been added and proper allowances for depreciation, repair and insurance. The rate of insurance on cargoes on the inland navigation routes is taken at 25 cts. per $100, and that on the open lake routes, 1, 5 and 9, at 50 cts per $100.



PROPOSED WATER ROUTES FROM THE UPPER LAKE PORTS TO NEW YORK AND TO MONTREAL.

Table of Distances from Chicago To:

	Miles.
Montreal via Lakes and St. Lawrence Canals	1,288
" " Michigan and St. Lawrence Canals	854
" " Ottawa Navigation	970
New York via Lakes and Erie Canal	1,400
" " Ottawa and Champlain route	1,353
" " Michigan and Erie Canals	993

Cost of Carrying a Bushel of Wheat from Chicago to Liverpool by Various Routes.

1. Present St. Lawrence Canals:		
Chicago to Montreal	5.50	cts.
Transfer at Montreal	.75	"
Montreal to Liverpool	6.50	"
Chicago to Liverpool	12.75	"
2. Present Erie Canal and Lake Steamers:		
Chicago to Buffalo	1.37	cts.
Transfer at Buffalo	1.30	"
Buffalo to New York	2.64	"
Transfer at New York	1.50	"
New York to Liverpool	5.43	"
Chicago to Liverpool	12.24	"
3. Erie Canal deepened to 9 ft.:		
Chicago to Buffalo	1.37	cts.
Transfer at Buffalo	1.30	"
Buffalo to New York	1.56	"
Transfer at New York	1.50	"
New York to Liverpool	5.43	"
Total	11.16	"
4. Erie Canal deepened to 14 ft.:		
Chicago to Buffalo	1.37	cts.
Transfer at Buffalo	1.30	"
Buffalo to New York	0.93	"
Transfer at New York	1.50	"
New York to Liverpool	5.43	"
Total	10.53	"
5. St. Lawrence Canals deepened to 14 ft.:		
Chicago to Montreal	2.18	cts.
Transfer at Montreal	.75	"
Montreal to Liverpool	6.50	"
Total	9.43	"
6. Ottawa-Champlain Route:		
Chicago to Montreal	1.50	cts.
Montreal to New York	.57	"
Transfer at New York	1.50	"
New York to Liverpool	5.43	"
Total	9.00	"
7. Ottawa Navigation:		
Chicago to Montreal	1.50	cts.
Transfer at Montreal	.75	"
Montreal to Liverpool	6.50	"
Total	8.75	"
8. Erie-Michigan Route via New York:		
Chicago to New York	1.75	cts.
Transfer at New York	1.50	"
New York to Liverpool	5.43	"
Total	8.68	"
9. Erie-Michigan Route via Montreal:		
Chicago to Montreal	1.92	cts.
Transfer at Montreal	.75	"
Montreal to Liverpool	6.50	"
Total	9.17	"

An inspection of this table will show how heavily New York is weighted in the race by her present port charges, which are only ½ mill less than the whole cost of carrying grain from Buffalo to New York by the Erie Canal, 493 miles, when enlarged to 9 ft. Were they reduced from 1½ cts. to the Montreal rate of ¾ ct., New York would be beyond competition.

A very important question is whether the new and improved routes could compete better than the present Erie Canal with the railways, which now transport over 80% of the grain coming from the West to New York. This can best be answered by an illustration. Mr. Leiter is said to have lately made a contract for a large shipment of wheat from Chicago by all-rail to New York and thence to Liverpool, for 16.05 cts. per bushel. Why did he not wait a few weeks and ship it by steamer to Buffalo and canal to New York, at a cost of probably not over 12 cts. per bushel to Liverpool? He would probably reply, that by sending the wheat by rail he could get negotiable bills of lading on shipment and be sure of the time of arrival. Had he waited and shipped by canal, in its present state, he would have been obliged to make separate contracts with many canal-boat men, none of them responsible for time or delivery as a railroad company is. A drop in the market might eat up all the apparent saving.

What would happen if the proposed Erie-Michigan route were operated? The enormous saving in the cost of transporting grain between Chicago and New York would lead to the organization of responsible companies, owning their own fleets of tug-boats, steel barges and fixed and floating elevators at New York. They would issue negotiable bills of lading on shipment as a railroad company does, and guarantee time of delivery. Their competition would reduce the present charges for storing and shipping grain at New York to an amount not exceeding those at other ports.

If both of these suggested routes can be improved, they would give to the western grain producing States and to Northwest Canada, two new outlets to the sea, costing far less than any ship canal would cost to build, or to carry grain in by ocean steamers. The Erie-Michigan route would best accommodate Chicago, and the Ottawa-Champlain route, the Lake Superior ports. The cost of carrying grain from the Lake ports to Liverpool would be reduced from its present amount of 16 and 12 cts. per bushel to 8½ to 9 cts. per bushel. This would enable us to meet the competition of Argentina, Russia, and other countries which export wheat.

What is needed now is that Congress shall provide for making surveys for these two routes in addition to a detailed survey for the enlargement of the Erie Canal recommended by Major Symons. So far as the Lake Champlain route is concerned, the estimate of cost can be obtained without cost to the government. The Deep Waterways Commission is now engaged in surveys for a ship canal by the Champlain route, and it only requires instructions from Congress to enable it at the same time to investigate the cost of a barge canal over this route, with practically no additional expenditure. For the survey of the proposed canal across Michigan, Congress might well either appropriate a small sum or else instruct the Deep Waterways Commission (which has already received $150,000 and will receive $225,000 more by the present Sundry Civil Appropriation bill) to use part of its funds in making this survey.

IMPROVEMENT OF THE MOUTH OF THE MISSISSIPPI RIVER.*

By Thos. L. Raymond, M. Am. Soc. C. E.

A brief review of the methods which have been tried or suggested in the past for the improvement of the entrance to the Mississippi river will be useful in this discussion, and these methods will be the better understood if we recall the conditions which have prevailed at and near the mouth of the river, as determined by the unmodified work of nature. At a distance of 25 miles from the Gulf, measured along the channel, the river is 2,700 ft. wide, with a maximum depth of 94 ft. Just below this point the west bank was breached by a crevasse many years ago, and an outlet formed called "The Jump," which is twelve miles long, very narrow, only 12 to 14 ft. deep, and debouches into 4 ft. depth in the Gulf, at a distance of seven miles from a 30 ft. depth in the Gulf. Another opening in the east bank, seven miles below the Jump, is known as Cubit's Gap. This may be considered as one of the mouths of the river, and it empties into the Gulf through a channel 4 to 7 ft. deep at a distance of nine miles from a 30-ft. depth. Opposite Cubit's Gap, the width of the river has increased to 4,100 ft., and its depth decreased to 50 ft., and this widening and shoaling progresses until the "Head of the Passes" is reached; where the width of the river is 6,900 ft., and the depth 33 ft., in a channel entering Pass a l'Outre.

The river here divides into three main streams, viz., Pass a l'Outre, flowing about East; South Pass, flowing Southeast, and South West Pass, named from its course. Pass a l'Outre, before the work on South Pass was begun, was 14 miles long, and carried from the river 46% of the whole volume of the river reaching the Head of the Passes. For the upper third of its length it afforded to commerce a channel 1,500 ft. broad and a least depth of 50 ft.; but in its further progress to the sea, this great volume was and is depleted by a number of outlets, two of which are of very considerable capacity, leaving a volume of water in the main channel which requires a width of 1,100 ft. and a depth of scarcely 40 ft. to carry it to sea. The rate of this current is so much reduced by this repeated lowering of the head, or flattening of the slope, that the depth over the bar was only about 9 ft. During the last four years this deterioration has doubtless been augmented by the formation and enlargement of another great outlet known as Pass a l'Outre Crevasse, only two miles below the Head of the Passes.

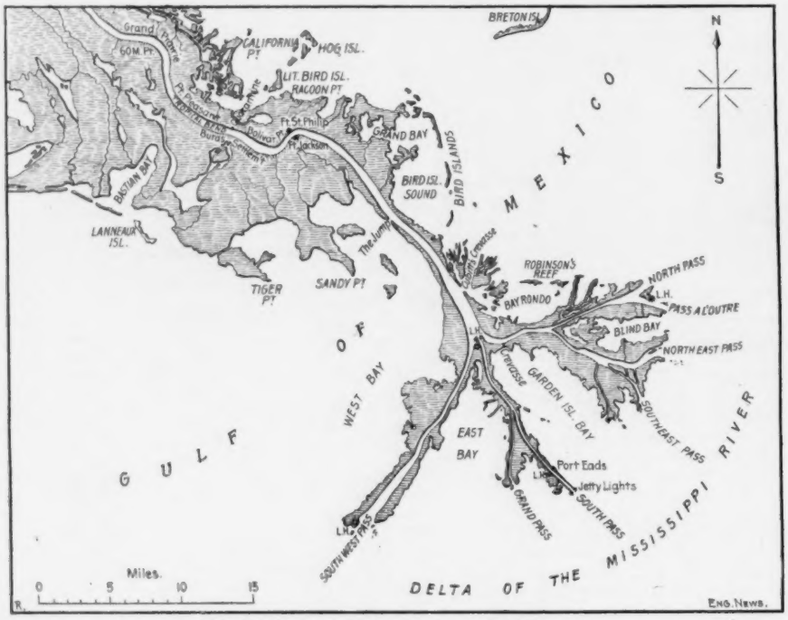
South Pass, before Mr. Eads began the work of its improvement, was ten miles long, and carried only 11% of the total volume passing through the three mouths. The entrance to it from the river, was divided into two channels by an island, while the main banks widening out to a funnel shape to enclose it, had the effect of gorging the water entering the Pass at its narrow throat, reducing the slope and consequently the current through the wider part above, and thus formed a bar across the entrance with only 15 ft. of water over it. For a short distance down in the Pass, with a width of about 650 ft., a depth of 38 ft. and over was maintained; but below this stretch the width, enlarging to 1,100 ft. to enclose another island, and reduced the depth to 30 ft. Five miles below the head, an outlet through the west bank drew off to the sea as much as 23% of the total volume entering the Pass with the inevitable diminution of depth to as much as as 10 ft. less than what was found above. A short distance above its mouth, a small outlet still further reduced its current and capacity, and finally at a distance of 1½ miles from shore, the crest of the bar was found with a depth of only

*Paper read before the Louisiana Engineering Society, March 14, 1898.

8 ft. over it. Through a great part of its length the width of this Pass is only 600 ft.

South West Pass carried 43% of the water in the river below Cubit's Gap. Its least width is about 1,200 ft., and its channel depth varies from 50 to 78 ft. through twelve of its fourteen miles of length, and the shoaler two miles are at its mouth, where the banks widen out to the open sea. The depth of the channel over the bar was usually about 15 ft., while this Pass was being used constantly as the entrance to the river, but it has since shoaled to about 9 ft.

There have been several methods suggested by engineers of repute for obtaining a deeper channel into the river from the Gulf than nature has provided. The first and simplest was by dredging through the bars by harrows; but this was soon abandoned, when the difficulties of working in the open sea were encountered, and the action of the cross-currents in refilling the narrow cut, was learned by experience. The second plan attempted to protect the channel by a sheet pile jetty on the east side and excavating under its protection. This plan succeeded in opening a channel through South West Pass bar 18 ft. deep, but the protecting wall was soon destroyed by storms, and the contractors failed to obtain



MAP OF THE OUTLETS OF THE MISSISSIPPI RIVER.

the 29 ft. guaranteed by them. The third method was adopted by the United States government, about 1870, and consisted in stirring up the material composing the bar with large propellers, lowered to the proper depth, deflecting the surcharged water to the surface, and thus utilizing the strong current to transport the suspended material to deeper water. Two larger and expensive vessels built for this purpose succeeded in obtaining 18 ft. depth by this method across South West Pass bay for a part of the time during three years, but the results were extremely unsatisfactory, as the channel was quickly obliterated by storms; was very narrow; and, as only the finer material was removed ,the bottom became dangerously hard from the greater proportion of sand remaining. The fourth method was that of flanking the mouths of the river by a canal with locks, connecting the deep water of the river with that of the Gulf at a point some 33 miles from the mouth. The object to be attained by this plan was the prevention of the bar formation, by avoiding the constant flow of sediment-charged water through the entrance to the Gulf. This plan never reached a stage beyond that of surveys and estimates. It was first suggested in 1832 by Chief State Engineer Bullson, and was revived in 1870. The discussion of its merits in comparison with jetties was long and bitter, but after volumes had been written in defence of both projects, the jetty plan was adopted tentatively by the general government, on the guarantee of a private individual to make a success in South Pass.

Whatever may or could have been claimed for the canal in the early 70's, was based on obtaining a navigable depth of 25 ft., considered at that time ample for the commerce of the world; but as the vessels of the present day require at least a 30-ft. depth, with the prospect of this being exceeded in the future, a glance at the chart will show, that no safe navigation for such draft can be found through Breton Sound, which it was proposed to connect with the river by canal. Looking at this in the light of what has been accomplished by the jetty plan, it would seem out of the question to abandon a splendid natural canal of ample width and depth, with only four miles of shoal water dividing it from the deep basin of the Gulf, and to construct ten miles of artificial waterway limited in width and depth by considerations of cost, subject to the delays and uncertainties of lockage and finally reaching an arm of the sea difficult of safe navigation. For a vessel of 30-ft. draft Breton Sound is not possible for safe navigation, and a locked canal between it and the river is impracticable at any reasonable cost.

The last and only successful plan was and is the jettying of one of the Passes. This method of bar improvement has, since the construction of those at South Pass, been applied, with numerous modifications and with varying degrees of success, to many other harbor entrances in the United States. It aims to do suddenly in the process of bank building, what the slow process of nature accomplished only in centuries. Seaward of all harbor entrances, the conflict of the littoral with the outflowing currents checks the movement of the sediment or sand carried by either, causes deposit and forms bars, the depth over which varies with the many varying conditions.

The Mississippi, below St. Louis, is a marvellous type of a sediment bearing river, and it has been estimated that it annually transports to the Gulf a volume of solid material represented by a mass one mile square and 260 ft. high. The shoals which blocked the entrance to all of its "Passes" were built up chiefly by the material carried out of the river, which is dropped by the current progressively, as its rate is diminished with the widening of the distance between the banks, and more rapidly, after the open sea is encountered. As is to be expected, the greatest amount of deposit occurs on either side of the thread of the current, though the western side of all the entrances is built out more rapidly, due perhaps to the sea currents being controlled largely by the prevailing winds, and also to the rotation of the earth from west to east, depositing a greater proportion of the drift and suspended material on the western side. The momentum of the current, the shoals on either side beyond the north and the head retained as far as the visible banks extend, produce a current which is able to support and carry material some distance into the Gulf, and these factors regulate the distance from land's end to the crest of the bar. The distance from 30 ft. inside to 30 ft. outside is, at Pass a l'Outre, 3¾ miles, from South West Pass, 4½ miles, and for South Pass, before its improvement, 2¼ miles. As the process of bank extension progresses from year to year, the rate of flow is maintained for a greater distance into the Gulf, carrying the material further and producing a yearly bar advance, which has been the cause of great doubt in the minds of many unprejudiced students of the problem, as to the economic success of the jetty system at the mouth of the Mississippi. This annual bar advance has been estimated by comparison of surveys extending over many years at, 300 ft. for Pass a l'Outre, 100 ft. for South Pass, and 260 ft. for South West Pass, and the fear has been entertained that, with jetties completed, this rate might be greatly augmented, as much as four-fold having been claimed by some. This being the chief argument of value to my mind, against the improvement by jetties, I beg leave to dwell upon it for a few minutes.

Briefly stated, the jetty system may be described as the extension of the banks of the stream out to sea as rapidly as possible by substantial structures built upon the shoals on both sides of the axis of the discharge channel, and extending this confinement of the flow beyond the crest of the bar. The immediate effect of this sudden acceleration of the current across the shoals, is to scour out a channel to a depth which is dependent upon the width of waterway between the jetties. This deepening may be carried on to an indefinite limit, even to the undermining of the artificial banks which induce it by contracting the width of discharge, or lessened to any desired by locating the jetties at greater distances apart. On the completion of the jetties the formation of a new bar is immediately begun, presumably at about the same distance from the mouth, as was the crest of the old bar from the natural shore line; but this new formation is modified by several conditions. First, the head due to the combined waters, being transferred to the crest of the old bar, diminished only by the slope in the length of the jetties, produces a greatly increased velocity at the exit into the open sea, increasing the momentum of the outflowing volume, as well as the length of the slope to sea level, thus carrying suspended material a greater distance. Then as the bottom slopes downward, instead of upwards, as with the natural mouth, the sediment having increasingly greater distances to fall through a heavier medium to the bottom, is deposited at greater distances than when the upward grade of the bottom, as much as 1 ft. in 200 ft. rises at every foot to catch the descending particle. Lastly, the lateral distribution, by the immediate discharge into deep water is unimpeded by the shoals extending on either side to the natural bar, and the littoral currents have opportunity for their maximum effect in distributing the bar forming material over more extensive areas. The velocity of the current, one mile beyond the end of the jetties at South Pass, has been observed to be as much as 2.8 ft. per sec.

This theory would indicate a slower bar advance, and 20 years of experience with the South Pass jetties furnishes the unimpeachable testimony of facts. Mr. Donovan, U. S. Assistant Engineer, in charge of examinations and surveys at South Pass, has studied this bar formation very closely, and the results of his observations are extremely interesting. In the 19 years between 1876 and 1895 the greatest fill observed directly in front of the mouth of the jetties was 11 ft. at a distance of 1¼ miles from the entrance, where the original depth was about 70 ft. Comparing the distances from the end of the jetties to certain depths which existed before and since the improvement, it is found that since 1877 it is necessary to advance about 1,800 ft. further into the Gulf to reach 70 ft. depth than was necessary at that time, or in other words, the 70 ft. depth has advanced by shoaling about 1,800 ft. in about eighteen years, but the 40-ft. depth has moved seaward only about 900 ft. in the same time. The greatest fill is, therefore, taking place in what was originally 70 ft. deep at a rate of about 0.6 ft. per year. In the same time, the 100-ft. depth has moved from a distance of 6,500 ft. to 8,000 ft. out to sea. It does not seem reasonable that this shoaling in deep water should be classed strictly as bar advance, as applied to the movement of the natural shoal, for should this shoaling continue at the same rate, 30 years and more must elapse before the shoaling will reduce the navigable depth to 30 ft.

Considering then the failure of all other methods of obtaining a deep water channel to the Gulf, and that the jetties at a moderate yearly cost for maintenance have given commerce a safe and reliable channel for 18 years for vessels of even greater draft than it was designed to accommodate, there should be no question at this time, when a wider and deeper waterway is demanded by the increasing size of merchantmen and war vessels, that one of the three Passes should be improved by this method to the required capacity. The only point to determine is which of the three should be thus improved. At first thought it seems simplest and most economical to increase the depth and width of South Pass, utilizing the work already done. There are, however, serious, and to my mind, fatal objections to the accomplishment of this. It will be admitted that the only means by which the Pass can be economically enlarged, is by diverting more water into it. To do this it is necessary to increase the head of water above it and prevent its seeking other routes to the sea, by partially damming other outlets, and forcing it to take its course by the unobstructed Pass. Any desired increase of volume could thus be added to South Pass, but when it is remembered that the scouring which would result, would attack the banks as well as the bottom, it cannot be doubted that such a course would be hazardous. The banks of all these Passes are perilously narrow in certain parts of their courses, and only solid enough to afford a footing within a few feet of the edge, while the tide ebbs and flows over the sea marsh behind. So unstable are they that it is almost certain that they have settled an appreciable amount in the past 20 years under the weight of deposits yearly formed upon them. To increase the width of South Pass to much more than 600 ft. which it affords now, would court the danger of a crevasse like that in Pass a l'Outre and the consequent destruction of the channel below it.

The jetties were built 1,000 ft. apart, and 900 ft. of waterway is the most that could be obtained between them, and this would involve the removal of wing dams and the inner parallel jetties built to maintain the present depth, while the danger of undermining would extend to the original

jetties. These seem sufficient reasons for abandoning the attempt to enlarge South Pass beyond its present dimensions, aside from any considerations of cost. So much was Mr. Eads impressed with these possibilities that he seriously contemplated preventing its further enlargement at one time, by throwing a sill across its head. If all repair work upon it were stopped now it would still, for years to come, accommodate all but the larger vessels entering the river.

Pass a l'Outre, for the upper third of its length, offers a sufficiently wide and deep channel to warrant the improvement of its bar; but below the South East Pass outlet, its cross-section rapidly diminishes. This involves not only the closing of that outlet and of the more recent crevasse, at great expense, but it means also the consequent shoaling, after this is accomplished, of this upper stretch by the diminution of its slope and the resulting check to the current. The enlargement of the lower stretch would certainly endanger the banks also, though to a less degree than in the case of South Pass. At the mouth where two channels now exist, one of them would have to be closed by expensive works, and then with these improvements to the Pass itself, the jetties over the bar could accomplish a result incomparably better than could be obtained in South Pass.

We come now to the consideration of South West Pass. Recurring to what has been already said it will be remembered that with a least width of 1,200 ft. it carries a least depth of 32 ft. through 12 of its 14 miles of length; which is at least 10 ft. deeper than is found in six miles of Pass a l'Outre. It has no outlets of consequence from head to mouth, and its course is almost straight. The distance from land's end to the crest of the bar, is greater than that at Pass a l'Outre, but the course of the single channel across it is flanked by shoals with a maximum depth of 9 ft., upon which jetties could be built. Finally the improved channel at South West Pass would be sheltered from storms from any direction east of South; and a few, if any, violent winds blow for any length of time from west of South, the harbor immediately inside of the jetties would be amply protected and the channel less liable to injury, than that at Pass a l'Outre which opens out nearly due east. The most important of all these advantages is that of the great depth throughout the Pass itself. The slope of the water surface, which for a given cross-section governs the rate of the current, is determined of course by the fall from the head of the Pass to the Gulf level, and the length of the Pass. The Gulf level at the lower end is constant, within the limits of tidal oscillation, and the height of the river at the head of the Passes, is fixed at a maximum by the height of the banks. The maximum head of the river in flood stages at the head of the Passes is about 2.5 ft., giving for South West Pass that much fall in its length of 14 miles, less the small amount in the open sea. Should the Pass be lengthened by jetties four miles, equal to 28% of its present length, the slope and current are proportionately reduced, and the Pass would immediately begin to shoal to accommodate the new conditions.

In the case of South Pass the closing of outlets tended to produce a shoaling above them and a deepening below, while the lowering of the head by Pass a l'Outre Crevasse also caused a shoaling; hence that due to the increase in its length alone cannot be ascertained. Before the break in Pass a l'Outre, however, a shoaling as great as 15 ft. had occurred in the deepest parts of the channel above the old outlet, and as much as 8 ft. below it. It is, therefore, essential that the original available depth in the Pass to be lengthened, should be as great as can be found, to allow for this certain shoaling. South West Pass, having a least depth below the head of the Passes of 32 ft., affords ample allowance for this deterioration; while Pass a l'Outre, for six miles of its length, has a depth but little greater than that required for safe navigation.

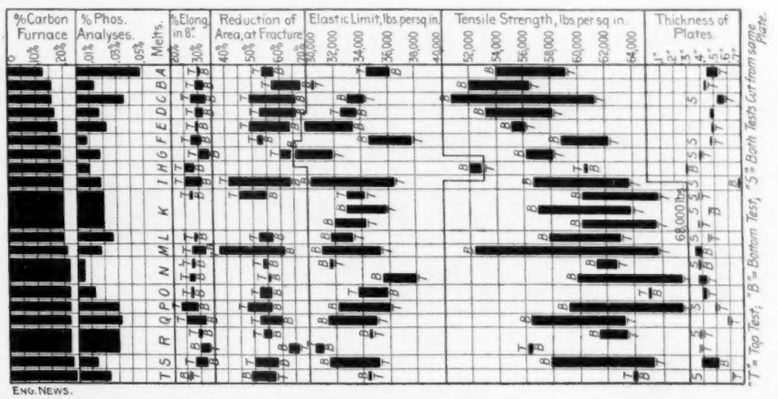
I have not presumed, of course, without the data furnished by detailed surveys to estimate the cost of this improvement; but remembering that the South Pass work cost the government $5,250,000; that experience with work of this character has largely reduced its cost of construction; that the materials, such as brush and stone, could be obtained now at nearly half the prices paid then; that much of the expensive work at the head of the Passes would not be required for South West Pass, and that enormous rates of interest were paid for the use of money in a work of doubtful success, it cannot be doubted that even with the greater work required for the greater Pass, the cost would be much less. At Sabine Pass, to July, 1896, the two jetties aggregating 34,000 ft. in length, and in depth gradually increasing to 16 ft. had cost $1,815,000; this including considerable dredging. Some 12,000 ft. of this work was built in depths of 9 to 16 ft., and the construction has been done under small contracts extending over a period of 16 years, adding greatly to the cost. South West Pass jetties proper would have an aggregate length of about 40,000 ft., but the substantial work could be located in depths not exceeding 9 ft., except at the extreme sea end, and lighter and much less expensive construction could be utilized to reduce the width as required; thus bringing the cost down to a sum comparable with that expended at Sabine Pass.

Finally, if what I have said in comparison of the three Passes is admitted as just, then the conclusion is inevitable, that South West Pass is best adapted to the needs of navigation, and that the removal of its bar by the jetty method will afford the most advantageous, capacious and enduring waterway, with a width of fully 1,200 ft., and a depth of at least 35 ft. in the navigable channel.

TESTS OF BASIC OPEN-HEARTH STEEL PLATES.

By T. L. Condron.*

The accompanying diagram has been prepared so as to exhibit very clearly the variation in the physical qualities of the tops and bottoms of the same ingots of steel, when these ingots have been rolled into plates. The 46 tests here presented were made by the writer, and represent 19 different melts of basic open-hearth steel. For each melt a "top" and a "bottom" test was made. As the plates, from which the tests were taken, were rolled direct from ingots the "top" and "bottom" tests were usually cut from the same plate. It will be seen that eleven pairs of these tests are shown as having been, in each case, cut from the same plate. Besides these eleven pairs there are five other pairs of tests, which if not from the same plate in each case, were taken from plates of identical gage; these are the tests from melts B, E, K, Q and R. In some, if not all of the latter cases, it is probable that owing to the ingots they represent being rolled into large sheets and two or more plates being sheared from a single sheet, the tests are recorded as cut from different plates, but are from the same ingot. Of the remaining seven pairs of tests, those for melts A, N, O and S, the "top" and "bottom" tests were taken from different plates in each case.


% Carbon Furnace Analyses.
% Phos.
% Elong. in 8".
Reduction of Area, at Fracture
Elastic Limit, lbs per sq in.
Tensile Strength, lbs per sq in.
Thickness of Plates.
Melts.
T = Top Test, "B" = Bottom Test, "S" = Both Tests Cut from same Plate.
ENG. NEWS.

COMPARISON OF TESTS MADE FROM THE TOPS AND BOTTOMS OF BASIC OPEN-HEARTH STEEL INGOTS ROLLED INTO PLATES.

The writer would call attention to the fact that it is generally possible for the manufacturer to so cut tests for plates as to have the tests meet the requirements of almost any specification. For example, supposing an order is received specifying "medium" steel having a tensile strength of from 60,000 to 68,000 lbs. per sq. in. The "top" test of the plate representing melt "C" gives a tensile strength of 61,140 lbs., which would generally insure the acceptance of the melt, while in reality this plate is clearly a "soft" steel plate. Again, in filling an order for "soft" steel, having a tensile strength of from 52,000 to 60,000 lbs. per sq. in., the melt "P" would be represented by the "bottom" test showing a tensile strength of 59,220 lbs., and this melt would be accepted for "soft" steel, while it will be seen from the diagram that the plate is clearly a "medium" steel plate.

These tests have not been specially selected for illustration, but are a series of "top" and "bottom" tests made by the writer in the regular course of his work as an inspector. He was led to suggest to an engineer for whom he was inspecting steel under a specification calling for plates of from 52,000 to 60,000 lbs. tensile strength, that the specifications be modified so as to read that "bottom" tests should show a tensile strength ranging between 50,000 and 58,000 lbs. per sq. in.; and "top" tests should range between 54,000 and 62,000 lbs. It will be seen that this modification insured practically "soft" steel being secured by the same ingot. It should be realized that ultra-refinements in specifications for steel must be supported by corresponding refinements as to the selection of tests and the number of tests that will be required. As a manufacturer will probably find ways to circumvent ultra-refinements, the most reasonable course for engineers to pursue is to make their specifications perfectly rational and reasonable, and insert nothing but that which is so important that it will be absolutely essential for the inspectors to require every clause to be lived up to.

Instead of the usual forms of specification regarding upper and lower limits for physical qualities of steel, and the way these qualities are to be determined, the writer would suggest that a study be given by the engineer to the purposes for which material is wanted in every case, the treatment it is to receive in the shop and in erection, and then have him decide just how wide a range in the strength and ductility he is willing to permit, making this range as liberal as seems reasonable. It should then be stipulated that it would be the inspector's right and duty to take such means as in his judgment were necessary to satisfy himself at any and all times that the material in all parts and in every way was in accord with the requirements of the specifications.

At the present time steel-makers are forced by the unreasonable narrowness in the limits of the specifications furnished them, and the great variety of specifications for material for identically similar purposes, to bend their energies to getting "the tests" to fit the specification, whether the material does or not.

In conclusion the writer wishes to quote in support of his statement above, one of the manufacturers, Mr. H. H. Campbell, of the Pennsylvania Steel Co., who makes the following statement in his most valuable book on "The Manufacture and Properties of Structural Steel."

> The plate rollers have been driven to expedients which are not dishonest, but which are dangerously near the line of deception. Thus, if it is required that a test be cut from one plate out of every ten, the manufacturer will leave a coupon on every plate and test strips which are cut from immediately next to them; after finding which plates fill the requirements, the coupons are cut from the others and the inspector is told that the pile is ready for him. If every plate is to be tested, then a

*Western representative of the Pittsburgh Testing Laboratory, Ltd.

coupon is left upon each corner and a continuous strip is privately tested by the maker. After finding which corner gives the best results, the other coupons are cut off and the plates submitted to the inspector. * * * It is by care in the preliminary testing rather than by improvement in the quality of material that advances have been made, and it is time that the fact be made known to engineers.

THE NEW MASONRY-ENCLOSED STAND-PIPE AT ST. LOUIS, MO.

A stand-pipe, 6 ft. in diameter and about 140 ft. high, with an independent overflow pipe 2 ft. in diameter, is now under construction at St. Louis, Mo. The character of the structure makes it necessary to enclose it with a tower, and as it is located on the Grand Ave. front of the Compton Hill Reservoir Park it was desirable that the tower be as pleasing to the eye as possible. The architectural design of the enclosing tower is shown by Fig. 1. The base of the tower will be faced with rock-faced Bedford bluish-white limestone; the subtower will be of white rock-faced limestone; the main tower will be of buff brick, and the trimmings of granite. The main roof is to be covered with white terra-cotta tile. The interior and exterior of the tower will be lighted by electricity. There will be twelve arc lights in the observatory, one at each column, and a cluster of incandescent lamps in a globe at the entrance. The stairway will be lighted with incandescent lamps.

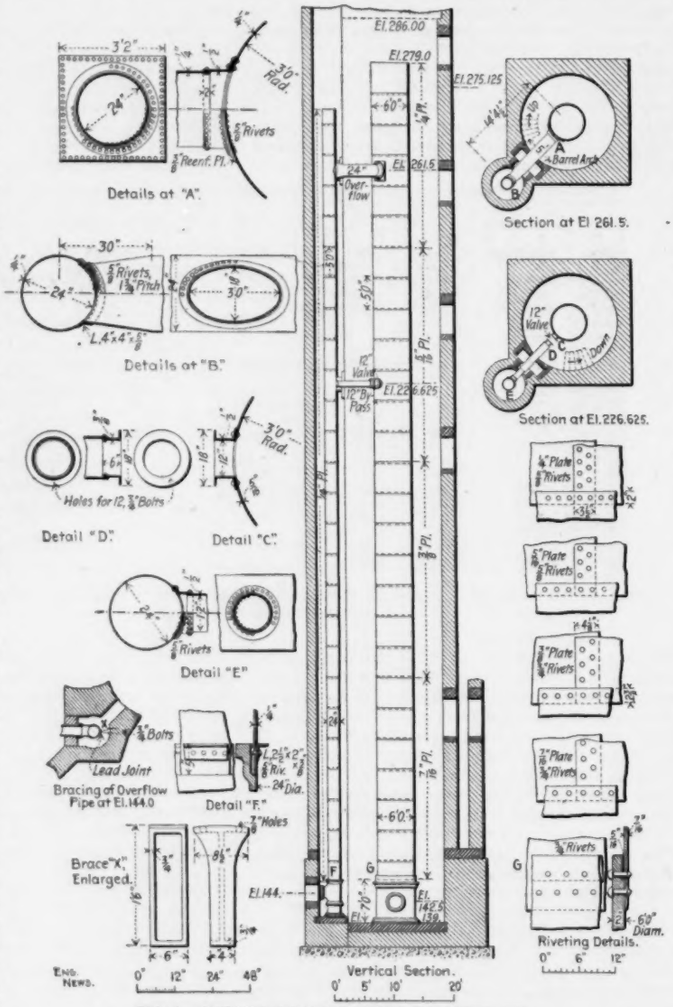


FIG. 2.—DETAILS OF STAND-PIPE, ST. LOUIS, MO.

The general character of the structure is shown by the elevation and sections, Fig. 1. Details of the stand-pipe, overflow and connections, are shown by Fig. 2. The method employed to fasten the tiles to the roof frame are shown by Fig. 3. The stand and overflow pipes are to be of soft steel, with rivets of soft charcoal iron. The plans and specifications for the whole structure were made and the work will be superintended by the Water-Works Extension Division of the St. Louis Water-Works, under the direction of Mr. M. L. Holman, M. Am. Soc. C. E. We are indebted to Mr. S. Bent Russell, M. Am. Soc, C. E., Principal Assistant Engineer in charge of the above division, for the information given.

Since the above was written we have received the following additional information from Mr. Russell:

> The stand-pipe is intended to regulate the pressure in the pipes of the upper high-service system; all overflow water from this stand-pipe will pass into a service reservoir, which regulates the pressure in the lower high-service. The stand-pipe shells are extended some distance above the overflow to provide against incidental surging, foaming or splashing or rise due to possible obstructions formed of ice. The by-pass is intended for the purpose of temporarily lowering the pressure in the high-service system.

THE USE OF FORMALDEHYDE AS A DISINFECTANT.

Within the past two years a new disinfectant, formaldehyde gas, has come to the front with astonishing rapidity. Although some of the original claims made for it are being modified by the accumulation of evidence resulting from laboratory tests and the actual disinfection of houses, yet there seem to remain good reasons for believing that with the perfection of apparatus and increased knowledge and skill in using it a most valuable addition will have been made to the agents for fighting the spread of disease.

In the present stage of its development it is doubtful whether the average health officer will be able to perform a more thorough disinfection with formaldehyde than by some of the old methods, notably steam and sulphur dioxide. Perhaps nothing will ever exceed steam in efficiency, under a wide variety of conditions, and burning sulphur is so exceedingly simple that almost anyone can be taught to use it effectively. But steam cannot readily be used, except at central stations, and both it and sulphur dioxide are injurious to some articles of clothing and furniture. Formaldehyde can be used under almost any imaginable condition, and practically without injury to any material with which it would come in contact when used as a disinfectant. Moreover, the odor of the formaldehyde may be neutralized in a very short time by the use of ammonia, although an airing will remove the odor, if a reasonable amount of time be allowed.

Formaldehyde gas is a product of the oxidation of wood or methyl alcohol, with the symbol $C H_2 O$. Two molecules of it readily unite to form a liquid and three to form a solid. In practice the gas is obtained for use as a disinfectant by (1) direct generation; and by regeneration from (2) the solution or (3) the solid form. Heat is required in each of the three methods. The gas is introduced into the room to be disinfected either by generation within the room, or by piping it in through a small aperture, such as a keyhole, from a generator located outside.

The gas was discovered in 1868 by Prof. A. W. Hoffman, a German chemist. In 1888, Mr. A. Trillat, a French investigator, discovered its germicidal qualities. He continued his investigations, and in 1892 submitted his results to the French Academy of Sciences. The possibilities of the gas were first brought prominently before Americans by Prof. F. C. Robinson, of Bowdoin College, Maine, who showed a lamp of his own devising at the Buffalo meeting of the American Public Health Association in 1896. At the last meeting of the American Public Health Association, held at Philadelphia last fall, a number of papers on formaldehyde were presented. A summary of these appeared in our report of the meeting in our issue of Nov. 4, 1897. These papers will doubtless be published by the association in due time, but for definite information on this point Dr. C. O. Probst, Secretary of the association, should be addressed at Columbus, O. Professor Robinson is Chairman of a Committee on Disinfectants, and under date of Jan. 29, 1898, informed us that he would "soon publish more experiments."

In the New York Medical Journal for Oct. 16, 1897, Dr. Alvah H. Doty and Dr. E. J. Lederle, both of New York city, each have important papers on formaldehyde. Dr. Doty gives, in brief, the history of formaldehyde, and describes its generation and qualities. He also gives detailed results of a long series of tests made by him to determine the germicidal efficiency of the new agent. Dr. Lederle presents the chemical features of formaldehyde. Dr. Doty concludes that for superficial disinfection

> of hangings, furniture, clothing, furs, silks and other articles which can be spread out and the surfaces exposed—formaldehyde is an agent of undoubted value, particularly as it does not, as a rule, injure the finest fabrics, and therefore may be safely used in an apartment furnished with delicate paper hangings and furniture.

It is very important to note that Dr. Doty says further

> that this agent cannot be depended upon for disinfection where deep penetration is required. It can, however, be relied upon to penetrate letters and other thin packages if placed in an air-tight chamber.

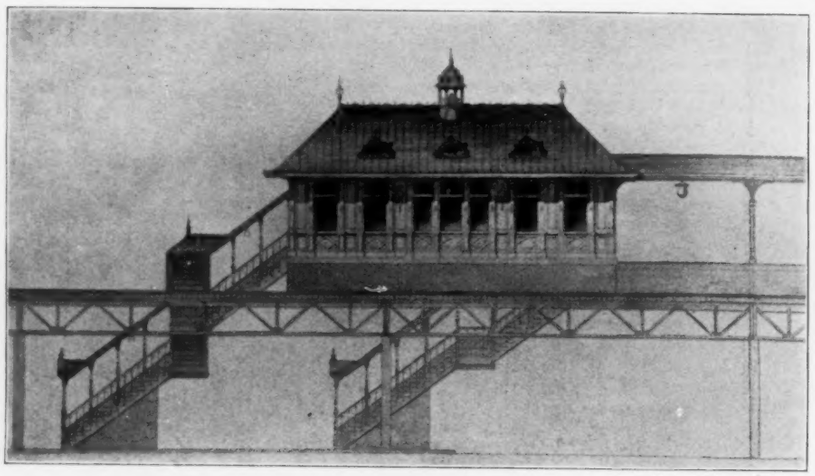
It is not always an easy matter to get rooms in dwelling-houses as nearly air-tight as Dr. Doty made his special compartments in some of his tests, a fact that should be borne in mind in considering his results.

In a paper on formaldehyde by Mr. O. I. Affelder, published in the Proceedings of the Engineers' Society of Western Pennsylvania for September, 1897, some improvements in apparatus are described and the results of tests to determine the proper amount of air and heat to be supplied to the generators are given.

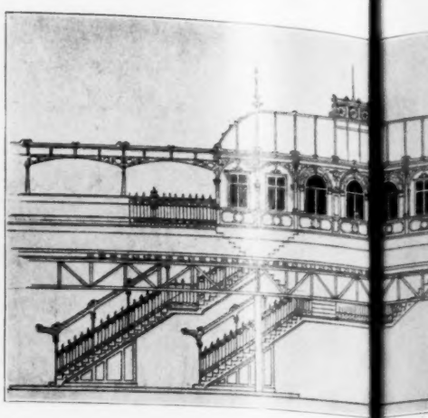
Those interested in formaldehyde will find the trade catalogues of the various manufacturers of generators of interest and value, some of them containing reprints or abstracts of disinterested articles on the subject, and each of them, of course, setting forth the peculiar claims made for the apparatus sold by its publisher. For the convenience of our readers we give below brief descriptions of a number of generators, with the names and addresses of their manufacturers.

The Sanitary Construction Co., of 56 Pine St., New York city, make the Sanitary Formaldehyde Regenerator. This consists of a closed copper receptacle for a 40% solution of formaldehyde; a copper vaporising coil; and a Swedish heating lamp. The gas is generated just outside the room to be disinfected and conveyed in through a small tube. The company sells formaldehyde solution ready for use. The solution contains at least 10% of methyl alcohol to prevent the precipitation of para-formaldehyde, or the solid form of the product, upon heating. H. K. Mulford & Co., of Chicago and Philadelphia, act as selling agents in the United States and Canada for the Sanitary Construction Co.

The Trillat system of producing the gas is represented in this country by Fries Bros., 92 Reade St., New York city. Trillat, as stated above, discovered the germicidal properties of this agent. In the Trillat system the gas is generated under pressure in an autoclave from formochlorol or a solution of formaldehyde to which calcium chloride has been added to prevent polymerization, or



A. W. LONGFELLOW, JR.,
(Accepted Design.)



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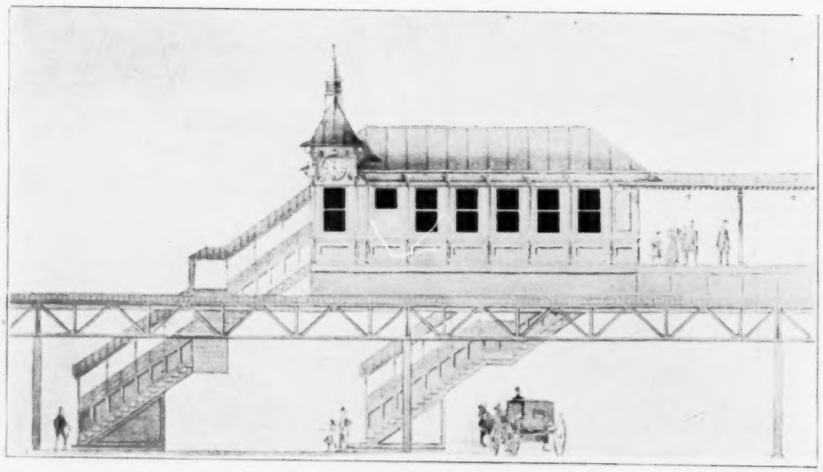
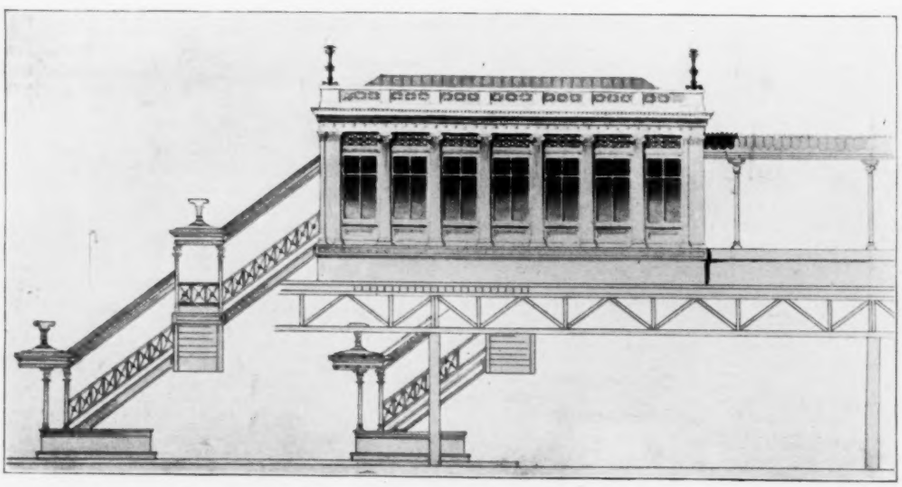


CABOT, EVERETT & MEAD.

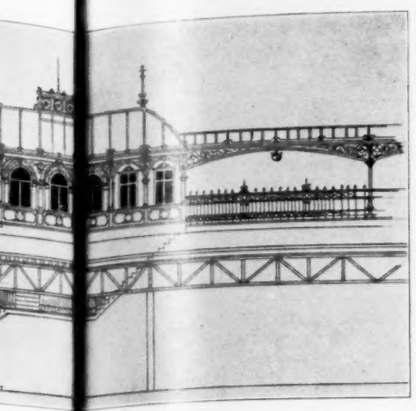
SHAW & HUNNEWEL



C. H. BLACKALL.

PETERS &

COMPETITIVE DESIGNS FOR BOSTON



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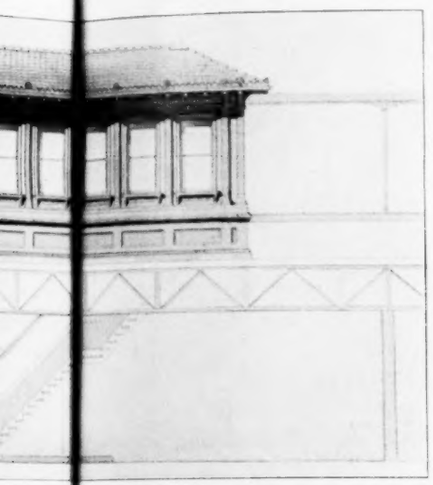
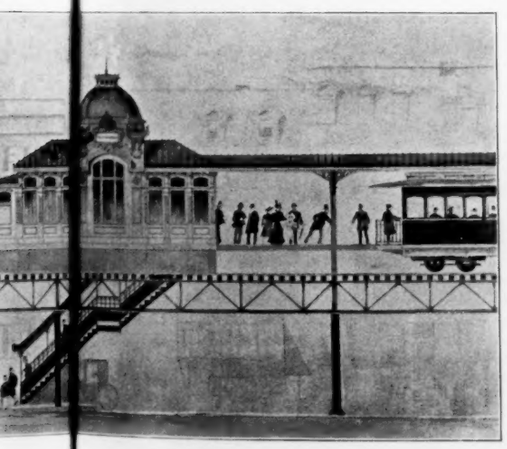
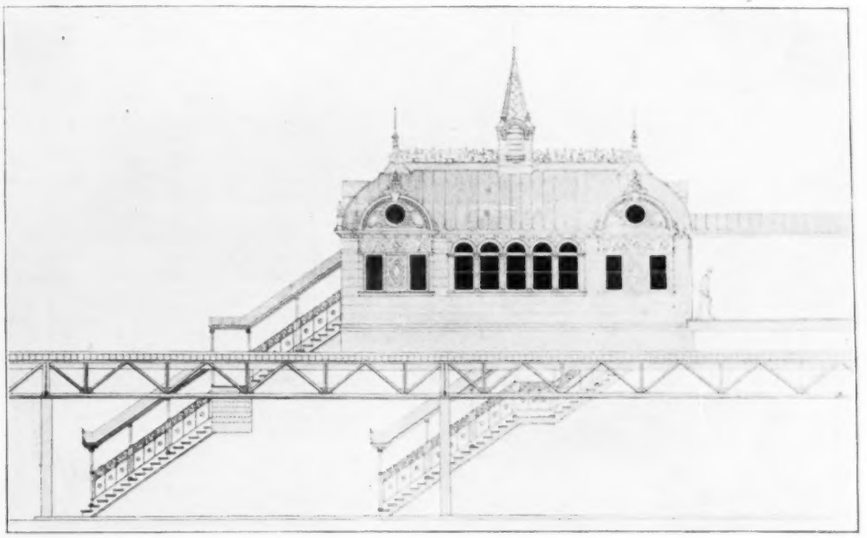


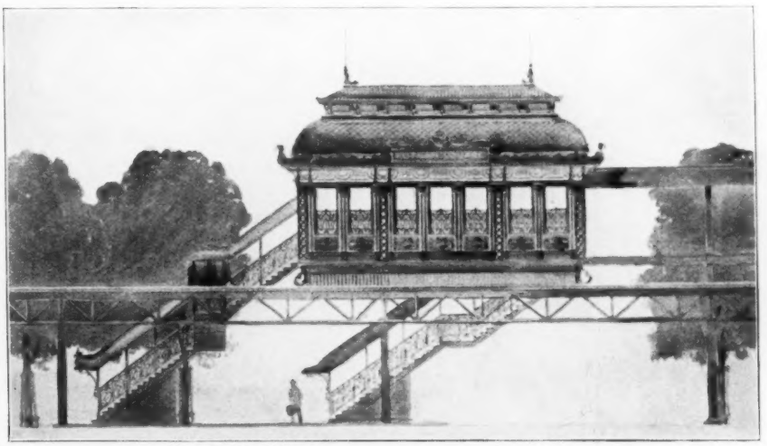
HAW & HUNNEWELL.



PETERS & RICE.



ANDREWS, JACQUES & RANTOUL.



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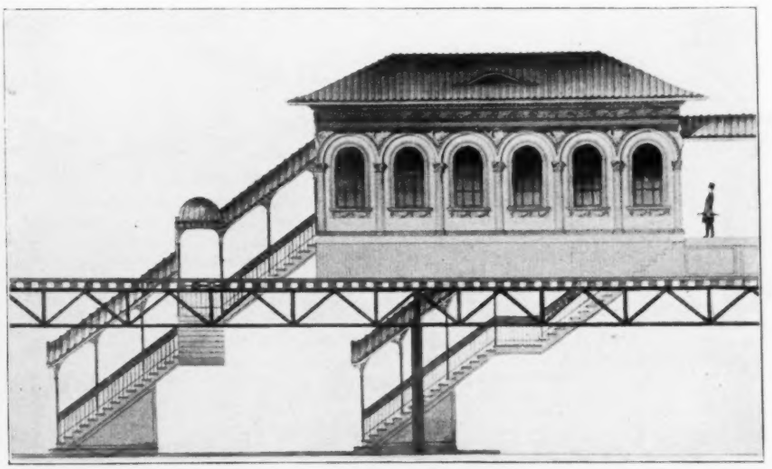

SHEPLEY, RUTAN & COOLIDGE.

FOR BOSTON ELEVATED RAILWAY STATIONS.

the formation of solid formaldehyde. This autoclave resembles those used in bacteriological laboratories for sterilization. It is of copper, "silvered," the makers state, "as the copper would in time be attacked by the formochloral." This apparatus, like the one described above, is placed just outside the room to be treated. It is patented "in all civilized countries," the makers say. Fries Bros. also make the solid form of the disinfectant, known as paraform.

The Kny-Scheerer Co., of 17 Park Place, New York city, manufacture and sell a form of autoclave known under their trade mark, as "The High C" Formaldehyde Gas Generator." The company states that this apparatus is endorsed by the U. S. Marine Hospital Service, and extensively used in its work; that it is strongly and technically made; and that a 40% solution of formaldehyde, combined with calcium chloride, is used. The gas is generated to a pressure of 40 to 45 lbs., and then liberated through pipes into the apartment to be disinfected.

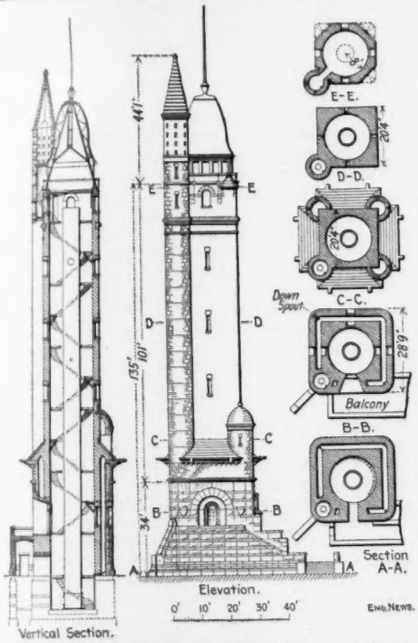

Fig. 1.—Plan and Sections of New Masonry-Enclosed Stand-Pipe at St. Louis, Mo.

M. L. Holman, M. Am. Soc. C. E., Water Commissioner; S. Bent Russell, M. Am. Soc. C. E., Principal Assistant Engineer, Water-Works Extension.

The Moffat Formaldehyde Apparatus, made by Eli Lilly & Co., of Indianapolis, is an alcohol lamp with a special chimney for the direct generation of formaldehyde in the compartment to be disinfected.

Another lamp for the direct generation of formaldehyde has recently been patented by O. I. Affelder, of Allegheny, Pa. It is described in the above-mentioned paper, and differs from others in that the supply of alchohol is regulated; and that the alcohol itself is not burned, the heat necessary for the reaction and for the evaporation of the alcohol being produced by burning gas. It is claimed that this lamp is more efficient and the process less costly than other direct generators. Preparations are now being made to put it on the market.

Some of the objections raised against direct generators are that they are beyond the control of the operator; that through improper combustion some of the alcohol may be wasted and thus an insufficient amount generated unless allowance is made for this, which would be wasteful in any event.

As to the generation of formaldehyde from paraform, as the substance in its solid shape is called, Dr. Doty states that this is a neat method, but not the cheapest, and that the generator is not under observation during the process, an objection just mentioned regarding some of the lamps. The paraform is furnished in sticks or tablets and vaporized by heating over a lamp.

Since the above was written there has appeared in the "Ohio Sanitary Bulletin" for February, 1898, a brief but most excellent review, entitled "The Present Position of Formaldehyde as a Disinfectant," by Dr. C. O. Probst, Secretary of the American Public Health Association, and also of the Ohio State Board of Health.* From this review we learn the names, but not the addresses, of the manufacturers of four more lamps or generators, as follows: The Hollister lamp, made by Truax, Green & Co., and the Robinson lamp, made by Sargent & Co., each using wood alcohol; the Disinfector lamp, made by Schering & Glatz, using paraform pastils; and the Generator lamp, made by Boydson.

We have made a brief quotation from Dr. Probst's paper on one of our editorial pages.

COMPETITIVE DESIGNS FOR STATIONS ON THE BOSTON ELEVATED RAILWAY.

(With two-page plate.)

Through the kindness of Mr. John Burnett, Secretary of the Boston Elevated Railway Co.,† and of the architects concerned, we are enabled to present in this issue reproductions of nine of the eleven designs recently submitted in a competition for stations for the new elevated railway system at Boston. Two of the architects preferred not to have their designs published, and so are not represented.

The railway company conducted the competition in a most creditable manner, inviting eleven architects to enter, giving each a retainer of $100, with a promise of $1,000 for the accepted plans. The company also selected an able man to aid it in awarding the honors of the competition, choosing for this purpose Mr. Wm. R. Ware, Professor of Architecture in Columbia University, New York city. The conditions of the competition were as follows:

Each competitor is to offer one design only. The drawings for each design are to be limited to three drawings, each on a sheet 22 × 30 ins., as follows: Two elevations—one end and one side—on a ¼-in. scale, and one ¾-in. scale drawing showing details. The drawings are to be rendered as the architect prefers. All drawings not accepted by the company to be returned to the competitors. Drawings are to be simply mounted on cardboard and delivered in a portfolio.

Plans to show a station costing not over $15,000, of metal, with wooden floors and wooden platforms. The elevated structure upon which the station will rest is not included in the amount stated, but the steps used for exits and entrances are included.

Each contestant to receive a retainer of $100. Plans to be filed with the secretary of the company, John T. Burnett, Esq., on or before Feb. 19, 1898. The architect whose plan is accepted by the Executive Committee of the company will receive $1,000 for his plans. The right is reserved to consult with a noncompeting architect should the Executive Committee so desire.

Architects will please sign the plans submitted by placing a motto thereon only and send with the design a sealed envelope containing name inside and motto on the outside. The company has at its office several photographs of island stations in New York and Chicago, which will be shown to any of the contestants if desired.

The names and street addresses of the eleven competitors, all being Boston men, are as follows, Mr. Longfellow receiving the award:

Shepley, Rutan & Coolidge, Ames Building.
Peabody & Stearns, 53 State St.
Winslow & Wetherell, 3 Hamilton Pl.
Peters & Rice, 621 Tremont Building.
Shaw & Hunnewell, corner Beacon and Park Sts.
Andrews, Jacques & Rantoul, 8 Beacon St.
C. H. Blackall, 17 Music Hall Building.
J. R. Coolidge, Jr., 89 State St.
A. W. Longfellow, Jr., 1124 Tremont Building.
J. Williams Beal, 55 Kilby St.
Cabot, Everett & Mead, 60 Devonshire St.

We are informed by Mr. Geo. A. Kimball, Chief Engineer of the Boston Elevated Railway Co., Exchange Building, Boston, that the stations are to have separate entrance and exit stairways, as may be seen from the illustrations. He also stated that it is expected, but not yet certain, that construction of the railway will be started this summer, and that about 6⅛ miles will be built at first.

EXPERIENCE WITH ACETYLENE GAS FOR CAR LIGHTING.

In our issue of March 3 we briefly noted the adoption of acetylene gas for car lighting on the Pontiac Pacific Junction Ry., of Canada. In response to our inquiries for more detailed information, Mr. P. W. Resseman, of Ottawa, Ont., General Superintendent of the company, has kindly sent us the following:

Sir: In reply to your favor of March 1, in reference to car lighting with acetylene gas on the Pontiac Pacific Junction Ry. Some months ago, in conversation with the local agents, Messrs. Holland Bros., of Ottawa, Ont., for the Niagara Falls acetylene gas generator, I suggested that acetylene gas would be a splendid lighting element for railway cars if it could be utilized without danger. Mr. Andrew Holland, one of the proprietors, asserted positively that he could light the cars safely and brilliantly with one of the generators used for house lighting.

The problems to be met were: 1. The effect of intense frost on the gas machine and on the gas when piped between cars with rubber hose, and when the train was running 30 or 40 miles per hour with the mercury away below zero. 2. The effect of vibration of cars on rough track on the steadiness of light. 3. The danger of gas escaping from the generator by the agitation of the water in the gas tank. 4. The slopping over of water from the gas tank on the floor of the car, and, in consequence, smell of escaping gas.

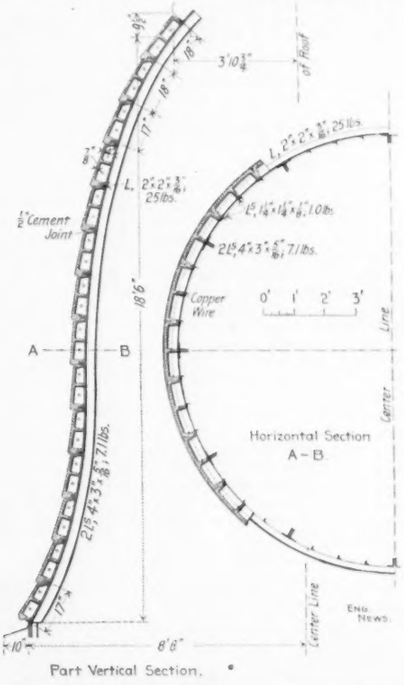

Fig. 3.—Manner of Fastening Terra-Cotta to Frame of Roof.

Shortly after this conversation I placed a train at Messrs. Holland Bros'. disposal for equipment. A 20-light generator was installed in the baggage car. The cars were temporarily piped for gas fixtures, and the first trial showed that three of the expected difficulties amounted to nothing in actual work—the tank and gas were not affected by the frost; the lights were not affected by the vibration of the cars, and the illumination was more brilliant than on any train I have ever seen. I believe it to be the most brilliant light used to-day on any train in the United States or Canada.

On through mixed express, as we run on this line, with all the drawbacks of shunting, etc., causing slopping over from water tank, during our first experiments, the light is so far ahead of anything that we have yet seen in economy and convenience that we will never go back to the oil system of lighting. Where a train has to be broken occasionally and cars shunted, however, it can readily be seen that such a system could not be worked. Here, again, Messrs. Holland Bros. came to our assistance and have installed a plant for us in each of our coaches that requires less carbide and avoids slopping, smell from gas and is positively safe, because the gas is only generated in such small quantities under low pressure that an explosion, even if possible, would not break a pane of glass. If the cars were to turn over the lights would go out, and the gas would simply pass away harmlessly into the air, as no fire could possibly result from it. The plant is installed in the toilet department; it occupies a floor space of about 14 × 26 ins. These generators have a capacity for the lighting of 6 lights of 50 c. p. each. The attendance of these generators is so simple that an ordinary chore boy attends to it without any difficulty or danger. We propose to equip all our cars with the acetylene gas plant, as being the cheapest, safest and most brilliant illuminant for railways yet discovered.

The carbide we use is manufactured by the Willson Carbide Co., of St. Catharines, Ont. It costs $60 per ton f. o. b. at the factory, and the lighting of one of our coaches with this light enables the passengers to read their evening papers from any seat in the car, and costs but 25 cts. for a six-hour's run.

*"The Bulletin" is published at Columbus, O., which is also the address of Dr. Probst.

†81 Milk St., Boston, Mass.

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Few people not engaged in the practice of medicine, nor connected with the work of health boards, realize the zeal with which each new disinfectant of any promise is sought after and its merits investigated. The latest and most promising candidate in this field is formaldehyde. The nature of this disinfectant and a brief presentation of its present status is given elsewhere in this issue. As an indication of the way in which the disinfectant is regarded by some of the leading hygienists of the country, we give below the concluding sentences of a paper on the subject, referred to at more length in our article, by Dr. C. O. Probst, Secretary of the American Public Health Association. Dr. Probst says:

> It would appear that formaldehyde, in sufficient amount, and under favorable but still debateable conditions, will destroy all disease germs. We have every reason to expect that these conditions will soon be known, and that apparatus for successfuly generating and applying the gas will be within our reach. But for the present I would say to the practical health officer who is, or is thinking of using formaldehyde as a disinfectant, what our present illustrious President said to Congress on the Cuban question—"Wait."

As circumstantial evidence of the soundness of this advice, we cite the experience of a local board of health in one of the New Jersey suburbs of New York, with which a member of the editorial staff of this journal is connected. Some months ago a formaldehyde generating apparatus was bought by the board, and put in use. Shortly afterwards two secondary cases of contagious disease developed in houses where formaldehyde had been used. The inspector who made the disinfection is a very careful man, and these were his first secondary cases in a year or so, reliance having been placed previously on some of the older disinfectants. Of course these secondary cases may not have been due to the shortcomings of the formaldehyde apparatus, but other users of it have had similar experiences. Like Dr. Probst, we believe it necessary to wait before placing full reliance on formaldehyde, although we think it promises remarkably well and we hope eventually to see its efficiency so thoroughly established that it may come into universal use.

The report, reviewed elsewhere in this issue, of the Metropolitan Park Commission of Massachusetts, might well serve as an inspiration for other communities to save before it is too late, beautiful expanses of natural scenery and open breathing spaces located in or near growing cities, but destined to disappear soon unless they are taken under public control. The commission named has for a few years past been developing a magnificent system of parks, parkways and river-bank scenery designed to meet the needs of Boston and 36 other municipalities located within a radius of about eleven miles from the State House in Boston. Areas of land both large and small have been secured on rocky or wooded hillsides, in valleys and along the seashore, unique in natural beauties, and affording fine views of land and water. These reservations and parks are being connected by means of parkways, and public accommodations are being provided where needed, notably an immense bathing-house at Revere Beach. The report of the board for 1897 includes a reprint of the text of a report made in 1893 by the late Chas. Eliot, Landscape Architect, on the needs and possibilities of the park and parkway system now being carried out. This report was written in a simple, straightforward way, but with a grace of expression that seems to have been inspired by the beauties of the scenery, for the preservation and greater accessibility of which the author was pleading. It is just this, the preservation of natural scenery and the making it readily accessible, that underlies the work recommended and carried out, and not any elaborate attempts at landscape architecture. Nature had lavishly played the part of architect. Man was about to lay ruthless hands on nature's work. The only action needed was the purchase and reservation of the land for the public use and the construction of ways to approach and traverse it. These ways have been made a harmonious part of the whole, binding all together. Aside from the parkways, where landscape work has been carried out, it has been more particularly directed to forming screens to hide the inharmonious works of man, or to restore what man has destroyed, such as the fringe of trees along river banks. All in all, the report of the board is very suggestive, and the report of Mr. Eliot, aside from its suggestiveness, deserves from its grace of style to rank as real literature, using that word in its highest sense.

In a late Presidential address before the Society of Engineers, of London, Mr. W. Worby Beaumont remarked that notwithstanding the multiplication of railways and canals, nearly every article consumed by the people of a country has to be transported on roads and highways for a considerable distance. Under these conditions good roads represent a national saving, as figured in the relative cost of this transport, and bad roads result in national loss. Taking the figures for England, Mr. Beaumont assumes that the cost of food and stabling for one horse averages about $150 per year; and if better roads would enable users to dispense with the services of 50,000 horses for a fixed amount of work, the sum saved per year would be $7,500,000. He estimates that, even in England, the cost of haulage is at least doubled by the bad condition of the roads; and money expended in the improvement of these roads would not only decrease the number of horses now required, but would leave nearly half of the one million horses in England to be employed in earning more money than they now do. Putting this additional earning power at $25 per year per horse, for, say, 450,000 horses, $11,250,000 would be added to the above $7,500,000, or $18,750,000 per year. At 3% this sum represents the interest upon $625,000,000, an amount that would go far in any country towards the development of highway construction.

While there are some fallacies in the deductions of Mr. Beaumont, and his figures might need some revision, the general tendency of such road improvement would doubtless be in the direction of a decided national gain. And if the figures of Mr. Beaumont are even approximately correct for the million horses of England, the comparative gain for the 16,000,000 horses in the United States would be enormous, and well worth figuring upon.

But a considerable saving can be made in the horse power required for a nation's highway traffic, even upon comparatively bad roads, by simply using broader tires on the vehicles now employed for hauling heavy loads. Last year an unusually careful and detailed set of experiments was made at the University of Missouri to test the influence of the width of tire on the draft of wagons. Without going into the details it is sufficient to say that on macadam and gravel roads the 6-in. tire, with a uniform tractive force, showed an advantage of from 25 to 30% in possible load over the standard 1½-in. tire. On dry, hard dirt roads, free from ruts and deep dust, the gain was about the same; 2 or 3 ins. of dust were unfavorable to the broad tire; and the same was the case on a clay road, muddy and sticky on the surface, but firm beneath. But on clay roads, with mud deep and drying on top, a large number of tests showed an advantage of from 52 to 61% for the 6-in. over the 1½-in. tire. These experiments were intelligently conducted and exhaustive in the variety of road tested and in the condition of these roads. They affirm previous, but less complete tests and have a very important bearing when applied to all the roads of the country.

THE PROSPECTS OF THE NEW YORK CANALS.

We discussed in our issue of Jan. 6 the question "What shall New York do with its canals," and reached the conclusion, as our readers will remember, that it would be for the best interests of the State to turn over the Erie Canal to the Federal Government. Our reasons for this conclusion were, first, the small probability that the State of New York will raise the sum necessary to complete the work of deepening to 9 ft.; second, the fact that even if this should be done, the canal would not be able to transport freight economically enough to meet the demands of the Northwest, or of those who seek to improve the position of New York city as a competitor for export trade; and third, the very strong probability that if the Erie Canal were now turned over to the General Government, it would be enlarged to accommodate vessels of 1,000 to 1,500 tons.

At the time we wrote, the Democratic press of the state was chiefly engaged in condemning, and the Republican press in defending those responsible for the expenditure of the $9,000,000 appropriation, which at the time the people voted it was supposed to be sufficient to complete the 9-ft. improvement. Of late the canal discussion has very wisely been turned to the much more practical question of what should be done with the canals in the future; and the movement for the transfer of the canals to the Government has gained friends on every hand and assumed remarkable proportions. The present state constitution expressly forbids the transfer of the canals by the state, and hence the first step in any such transfer must be an amendment to the constitution. To amend the New York constitution, the amendment must first pass both houses of the legislature, then both houses of a legislature elected in an "even" year, and finally be submitted to a popular vote. A concurrent resolution amending the constitution in such a manner as to make possible the transfer of the canals to the Federal Government, provided the latter would guarantee to maintain them as a free public highway, was offered early in the session by Senator Pavey, and nearly half the Senators have favored it. On the other hand, such influential commercial organizations as the Chamber of Commerce of New York have adopted resolutions condemning the resolution, though by no means unanimously, and the amount of influence brought against it appears at this writing sufficient to cause its defeat.

Should the Pavey resolution be adopted by the present legislature, it might be acted on again by the legislature of 1899, and then submitted to a popular vote at the election in November, 1899. If, on the contrary, the Pavey resolution is finally defeated, it will be impossible for New York legally to give permission for the Federal Government to improve the Erie Canal before November, 1901, no matter how much it might become for the state's interest that this should be done.

So much for the chances that the National Government can step in and improve the Erie Canal. Now what are the chances that the state will raise $7,000,000 to complete the 9-ft. improvement. They appear to us to be very small. As we have studied popular sentiment throughout the state, we have

seem no reason to believe that a popular vote for $7,000,000 more of canal bonds could possibly be secured. The political leaders are well aware of the condition of public opinion; and although a bill to submit such an appropriation to direct vote by the people is before the legislature, the Governor has announced his opposition to it, and the test votes already taken upon it indicate pretty clearly that it cannot possibly pass. Further, on account of constitutional requirements which we need not take space to explain, if the people do not vote on the $7,000,000 appropriation next fall, they cannot vote upon it before November, 1899.

If the reader has carefully followed this necessarily long explanation, he can now appreciate the probability that nothing further can be done for the improvement of the New York canals for at least three years to come.

Such an outcome reflects little credit on either the political shrewdness or the statesmanship of those who have so loudly avowed their friendship for the canals. Are they perfectly satisfied with the result of their labors? Do they really desire to have the canals left in their present status for three years to come? Do the Senators and Assemblymen at Albany wish to go home and face either their constituents who desire the immediate further improvement of the canals, or those who are clamoring for an opportunity to turn them over to the Federal Government and escape further burdens of taxation on their account?

Instead of defeating both the measures brought forward looking to the further improvement of the canals, it would seem to us far wiser for the real friends of the canals to bring about a compromise between the opposing factions whereby both measures might be passed.

If the $7,000,000 appropriation bill should be passed by this legislature, it could then be submitted to the people for approval next November; and if the vote on the appropriation should be a favorable one, those who are now opposing the Pavey resolution could exert all the influence they chose to defeat it in the legislature of 1899, and if unsuccessful there, at the polls.

On the other hand, suppose the people should vote against the $7,000,000 appropriation, and suppose also that Congress should show a strong disposition to undertake the radical enlargement of the Erie Canal, provided it were turned over to the Federal Government. These are probabilities by no means remote. Cannot those who have so strongly opposed Senator Pavey's resolution perceive that, under such circumstances, it ought to be at least possible for the legislature and the people of New York to be able to negotiate with the Federal Government for the carrying out of this great work.

Those who are opposing the Pavey resolution doubtless conceive that they are acting for the best interests of the state; but their attitude appears to us to be due to a misapprehension of the real state of affairs. Senator Pavey's amendment, even if it should pass the gantlet of two successive legislatures, and a popular vote, would not effect any transfer of the canals from state control. It would simply remove the present constitutional restriction against such transfer, which was framed at a time when the chance that the Federal Government would be willing to improve and maintain the Erie canal was not foreseen.

There are some other aspects to this question that should be noticed. The United States is now spending nearly $400,000 in making surveys for a ship canal of 28 ft. draft from the Great Lakes to the Atlantic. We do not believe that any channel of such size will be constructed, yet the fact remains that these surveys are being made; and we are aware that many people look on this scheme as one of the possibilities of the near future. Two main routes are under consideration for this canal one from Lake Ontario to a point near Rome, and thence along the line of the present Erie Canal to Albany; the other by the St. Lawrence canals and Lake Champlain. Should any such enterprise be undertaken, it goes without saying that New York would prefer the former route. But how a ship canal could be made along the Mohawk valley without destroying the present Erie Canal for the greater part of the way, it is difficult to see. Again, should the Champlain route be selected for a ship canal, or should a barge canal of large capacity be projected for that route, large parts of the present Champlain Canal would probably have to be appropriated. Could the United States override the constitution of New York and seize by condemnation these canals? It is very doubtful whether it would have any legal right to do so.

We desire to refer to still another matter. In another column of this issue, Mr. Thos. C. Clarke, Past-President of the American Society of Civil Engineers, calls attention to the early completion of Canada's 14-ft. navigation, all the way from Duluth to the Atlantic, and to the prospect, which he assures us is by no means a remote one, that the long-debated Ottawa navigation will be improved and made a water route for large vessels. Do New Yorkers think that a 9-ft. Erie Canal could meet the competition of these water routes? Do they really desire to obstruct the United States Government if it desires to make a competing waterway across New York?

Those who have been so conspicuous in opposing the Pavey resolution and in advocating the $7,000,000 appropriation, appear to have little conception of how much in earnest the people of the Northwest are in their demand for better waterways to the seaboard. New York may be satisfied with its 9-ft. Erie Canal; but the Northwest is not and will not be.

On the other hand, the Northwest is in nowise particular whether its products reach the seaboard by way of New York or by some other route. Congressmen from the Northwest would probably vote appropriations for a radical enlargement of the Erie Canal; but if the Ottawa route should be improved so as to give a deep waterway to the seaboard, their needs would be satisfied, and New York might keep its canals for itself.

These are a few of many reasons why it appears to us that a most serious mistake will be made if New York's legislature refuses to take the initial step toward making possible the improvement of its canals by the Federal Government. Those who have opposed the Pavey resolution have placed great stress on the importance of the canals to the maintenance of the state's commercial position; but if this position be correct, then the Pavey resolution ought by all means to be adopted, for it opens possibilities of greater improvement to New York's commercial position than the state unaided can possibly effect.

Since the above was in type, our predictions above as to the probable fate of the Pavey resolution have been verified. It was placed on its final passage in the Senate on March 29, and was defeated by a vote of 32 to 13. In the Assembly on the previous day it was taken off the calendar. The same influences that secured its defeat are now exerting every effort to secure the passage of the $7,000,000 appropriation bill; but those who oppose it may well demand that if the people are to be given an opportunity to say whether or not they will raise this further sum for the canals, they shall also be given an opportunity to say whether or no they will have the restriction removed that now absolutely prevents the improvement of these canals by the United States.

THE CHINESE RAILWAY SITUATION.

From late articles in "Engineering," of London, and from other sources, the railway situation in China can be outlined, so far as present prospects are concerned. But with the struggle for supremacy in the Empire now going on between four great Powers, the actual outcome of the immediate future can only be guessed at. One thing is certain; the partition of China among these Powers has had a beginning, and the door is opened to a development of the enormous resources of this country upon modern lines. The rapidity of this development will largely depend upon the degree to which each Power can extend its sphere of influence, and successfully combat the Chinese conservatism that has kept the Empire stationary for over twenty centuries.

Now, as to existing conditions, the original concession to the Belgian syndicate, for building the trunk line from Peking to Hankow, has been materially modified. The first concession, obtained with the support of the French Minister, granted to the syndicate a practical monopoly in railway construction throughout the Empire, and it gave an undue preference to Belgians and their associates. As this concession was contrary to the "most favored nation clauses" in the several treaties, the British, German and American Ministers protested against it; the monopoly clause was much modified, and the agreement was limited to the Peking-Hankow line. Despite the difficulty of raising Chinese capital required by the agreement, the contract has been settled and the line is to be built by Belgians, according to latest accounts.

In Northern Asia, Russia is displaying great activity, and the Trans-Siberian railway is completed to Krasnoiark, 2,650 miles from Moscow. M. Levat, a French mining engineer, lately made this journey from Moscow in 14 days, and reports great steel bridges in course of erection over the Obi, Yenissei, Biroussa and Oka rivers. The first two bridges are being built on the ice and are then to be lifted into position, and the Obi bridge is probably now completed. The Eastern of China Railway is rapidly completing its arrangements according to the agreement entered into in August, 1896, between the Chinese government and the Russo-Chinese Bank. The line is to be finished within six years after August, 1897. This is the new line of the Trans-Siberian Railway across Manchuria to Vladivostock, shortening the distance to that point at least 350 miles, as compared with the old location on Russian territory. The concession carries with it the right to build branch railways and operate all mines of minerals, and practically means Russian administration over all Northern China.

At the south end of China, France is pressing for railway concessions leading into the Empire from Lunchau, on the border of Tonkin, and from Laokai on the same border line. But Great Britain resents this proposed encroachment on what she regards as her sphere of influence. One result of the diplomatic controversy arising is the promise of the Chinese that no territory in the valley or region of the Yang-tse shall be mortgaged, sold or leased to any Power; and after next June the waters of the Yang-tse shall be open to navigation by the steamers of all nations. This latter concession, it is believed, will have a marked influence on railway development in China by creating a demand for improved means of communication between the river and centers of traffic some distance from the river. The British are also anxious to make connection between the Burmese railway system and China in the rich Province of Yun-Nan; but France is equally desirous of developing this province from Tonkin; and which Power will succeed in gaining its end is yet an unsolved problem. The British program is an ambitious one, and proposes no less than the linking of the Indian and Burmese railways, by building less than 600 miles of line, and thus securing a railway 3,150 miles long, extending from Karachi, on the Arabian Sea, to Kunlon, on the Chinese frontier. From Kunlon to Yan-nan-fu, in Yun-nan, is about 400 miles by railway location. In the Province of Shantung, on the peninsula separating the Gulf of Pechile from the Yellow Sea, the Germans claim to have a virtual monopoly of the railways and mines; but they have done nothing as yet.

Of railways in actual operation or construction, the port of Tientsin is now connected with Peking, and about 16 miles have been built from Peking south on the Peking-Hankow line. The railway from Tientsin north into Manchuria is being gradually pushed towards Monkden; the line is laid as far as Chung-how-so, and the embankment is built to the Ta-ling-Ho River. It is proposed to connect this line with the Russo-Manchurian railway in the Province of Kirin, and to thus provide an all-rail route to Russia and to Europe for the new Russian open seaport at Port Arthur. A development of long dormant resources of Northern China would naturally follow, especially in the extraction of valuable minerals.

The late reports that England and Japan have "cornered" the Eastern coal market, and thus have gained an advantage over Russia, Germany and France, call up another Chinese enterprise not mentioned by our contemporaries. That is, the proposed railway into the Province of Shansi, described at greater length elsewhere in this issue. According to the statements there made, this province contains not only an inexhaustible supply of excellent coal, but this deposit is immediately con-

nected with other equally valuable mines of iron ore and beds of limestone. Both our correspondent and the English press say that the concession to develop this mineral wealth has been secured from the Chinese government by a British syndicate; and that the concession carries with it virtual control over an area of about 10,000 sq. miles. The proposed railway is intended to bring this coal to the sea coast; and the addition of cheap fuel to the resources of the Empire, along with the industries that would inevitably be established in the Shansi region, must have an immediate and far-reaching effect upon the development of China. With the ability to supply its own railway and bridge material, the extension of railways should be rapid.

LETTERS TO THE EDITOR.

Silica Portland Cement.

Sir: The writer has followed very carefully all the articles on fine grinding of cements and on the strength of concrete mixtures resulting from the use of finely ground cements, and also the articles of Mr. Dankmar Adler, C. J. Wheeler and J. W. Dickinson, as well as the editorial note in the Engineering News of March 24. In this editorial you state that: "Silica cement is made from a mixture of sand and Portland cement, ground together to the fineness of pure cement." Allow me to correct this. Silica cement is ground almost three times as fine as pure cement. The leading American Portland cements will leave a residue of from 5 to 10% on a 100 mesh (10,000 sieve), whereas silica cement will not leave over 5% on a 180 mesh (32,400 sieve). This fine grinding has already proved itself of the utmost importance and interest to many of our prominent engineers and architects, and I hope will prove itself likewise of interest to the student of the future.

Very truly yours,
J. Maxwell Carrere.

66 Maiden Lane, New York, March 25, 1898.

Capacity of the Garbage Furnace at San Francisco, Cal.

Sir: I note the kind mention made of our incinerator in your issue of March 3. Will you pardon me, however, if I call your attention to the fact that the article you have put in is perhaps a little misguiding in some particulars. We are incinerating in San Francisco between 400 and 500 tons per day, and when you state that our San Francisco incinerator has 16 cells I think that you are confounding it with Montreal, which is a much smaller plant. Our plant here has 32 cells, but we can build an incinerator that would get away with from 10 to 1,000 or 1,500 tons per day if necessary. It is a mere question of adding a few more cells. We do not use fuel, therefore the cost of incineration is brought down to the actual wages paid employees. We have made some further improvement in our dumping platform in our San Francisco plant, which still further reduces the cost of incineration. I fancy San Francisco is now incinerating at a cost of somewhere in the neighborhood of 13 cts. per ton, which I think you will admit defies competition.

Yours very truly, Chas. J. Okell,
Secy. Thackeray Incinerating & Fertilizing Co.

401 California St., San Francisco, Cal., March 9, 1898.

The Surveyors-General of California.

Sir: I was much interested in the article by Mr. Van Ornum, in your issue of March 3, and endorse his remarks about the value of trained men in the offices of Surveyor-General and County Surveyor. In the Engineering News of March 17, however, was a letter from a gentleman in the Land Office in Washington, taking Mr. Van Ornum to task with reference to his statements about the Surveyor-General of California. In fact he flatly contradicted the previous statements.

As a matter of fact both gentlemen are right. Mr. Van Ornum referred to the State Surveyor-General, who is elected by the people. This state has, or had, millions of acres of public lands, principally swamp and overflowed, and tide lands, so that a Surveyor-General is a necessity. He has control of all the public lands and is ex-officio Register of State Land Office, but at present his duties are much the same as the United States Surveyor-General, a clerkship. At least that is what the politicians tell us when we try to have an engineer nominated for the office. He also issues the licenses to surveyors who qualify for a license. Since the office of State Engineer was abolished the Surveyor-General by statute is ex-officio State Engineer and is custodian of all the data collected by the State Engineer, Board of Public Works, etc. For this reason the engineers in California believe the office should be filled by an engineer. Some of the past incumbents are now self-styled engineers.

The Surveyor-General referred to by the later correspondent is the United States Surveyor-General with an office in San Francisco. I have always been under the impression, however, that the salary for the California appointee is $3,600 per year. This is simply on information gleaned from the newspapers within the past few weeks in discussions of possible appointees by President McKinley. The State roster gives the salary of the State Surveyor-General as $3,000 per annum and that of his Deputy, $2,400.

Yours truly,
Ernest McCullough.

Mills Building, San Francisco, Cal., March 24, 1898.

Concerning "Criticisms" on Recent Action by the American Society of Civil Engineers.

Sir: I beg to refer to a portion of the letter in your issue of March 24, 1898, entitled, "Criticisms on Recent Action by the American Society of Civil Engineers." My sole reason for asking this indulgence is that there might be a few members of the society who derive a wrong impression from the entanglements which Mr. Leverich has woven from premises which I shall show are incorrect.

In his letter Mr. Leverich assumes, first, that the function of the "Auditor," whose appointment is mandatory under the Constitution, is to audit the accounts; and, second, that no further auditing is required either by the Constitution or by the Board of Direction. Both of these assumptions are plainly erroneous; for, if Mr. Leverich had taken the trouble to read in full the Article of the Constitution from which he quotes, he will find in Sec. 3 this: "The accounts and financial books of the Society *shall be examined annually by an expert accountant*, to be selected by the Board of Direction," and again, in Sec. 9, this: "The Finance Committee *shall have immediate supervision* of the accounts and *financial affairs* of the Society; *shall approve all bills before payment*, and shall make recommendations to the Board of Direction as to the investment of moneys *and as to other financial matters*." (The italics are mine.)

As a matter of fact, the word "Auditor" in the Constitution is a misnomer, as the duties prescribed in the clause quoted by Mr. Leverich cannot be construed, in the exercise of commercial knowledge and common sense, to mean that he is anything more than a mere bookkeeper. The first "Auditor" appointed was the bookkeeper of the Society; and if I mistake not, your correspondent's immediate chief, Mr. C. C. Martin, then a Vice-President of the Society, concurred in this action. The appointment of the Secretary as Acting Auditor for the present year was made by the Board on the recommendation of the Finance Committee, because it was deemed desirable to comply with the letter of the Constitution, not to mention the saving of an extra payment on salary account by thus loading the extra function upon the willing shoulders of Secretary Hunt.

A reference to the reports of the Board of Direction for some years past will also show that each year the Finance Committee has reported that it has acted as an Auditing Committee. The present Committee made no change in this respect. All bills require the approval of the Chairman of that Committee before payment. He has "simply to examine and approve." And during the writer's experience the several Chairmen of that Committee have appeared to be "independent officials." Moreover, each year the accounts, books, vouchers and financial system of the Society are examined by an expert whose report is to the Board and is paid for special.

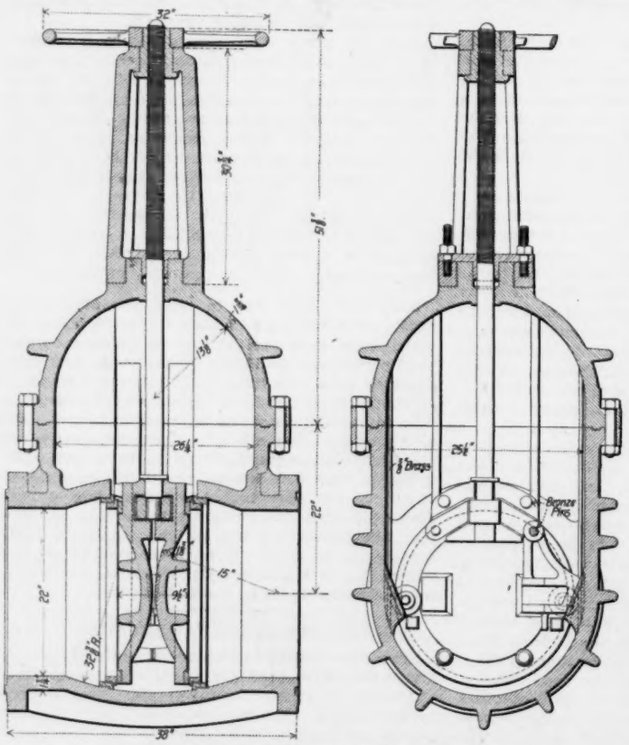
Doubtless the Constitution ought to be amended and the office of "Auditor," as therein specified, abolished. True, it does no harm; but it does no good. The volume of *business* transacted does not warrant it. To recognize it in the complete terms of the specification would be to simply make a "soft job" at the expense of the Society. If this ever comes, Mr. Editor, I hasten to notify your correspondent that I am first applicant; I apply now; it's the kind I, also, am looking for.

Yours very respectfully,
John Thomson,

253 Broadway, New York city. Treas. Am. Soc. C. E.
March 28, 1898.

A SPECIAL GATE VALVE FOR HIGH PRESSURES.

The valve illustrated in the accompanying cut is specially designed for use under high pressures of steam, water or gas, and is tested to a hydrostatic pressure of 750 lbs., and a steam pressure of 400 lbs. per sq. in. The valve has double disks, the backs of which are tapered transversely outward. Between them are hung swinging wedges tapered transversely to fit the disks and vertically to correspond with inclined faces in the case, these inclines being cast on each side of the ports. In opening the valve, the turning of the valve stem first releases the wedges, so that the disks can leave their seats without friction or grinding. In closing the valve, the disks travel clear of the seats until the parts are covered, when the wedges come in contact with the inclines and are forced inward, thus spreading the disks apart and forcing them against their seats.



THE HERCULES VALVE FOR HIGH PRESSURES.
Manufactured by the Michigan Brass and Iron Works, Detroit, Mich.

A special feature of the valve is the use of seats which are easily removable, although tight under high pressure. The faces of the valve bear against these removable seats, which are screwed into seat-rings of aluminum bronze, there being a ground joint between the two rings. The valve can be repacked while it is open. The illustration shows a 22-in. valve, with outside screw supported by a yoke, but they are made in all sizes, from ¾-in. to 24 ins., and with the screw outside, as shown, or enclosed in the chamber. In the latter case the hand-wheel is close to the top of the valve casing. The parts are put together with grooved and tongued joints, and the valves may be fitted with a by-pass. The body and top are of cast-iron, with steel bolts; the spindles are of steel or aluminum bronze, and the valve seats are of aluminum bronze in steam and water valves, or of special metals in valves to be used for acids and ammonia or other gases. Several of these valves are in use at the power stations of electric light and railway plants, and on the warships "Iowa" and "Brooklyn." These valves are made by the Michigan Brass & Iron Works, of Detroit, Mich., and are put on the market as the "Hercules" valves.

The same firm recently made a valve with a body of open-hearth cast steel for a high-pressure steam main at an armor plate factory in Sheffield, England. Its cost was more than twice as great as the cost of an ordinary valve with iron body and brass mountings. The steel castings for the valve were made by the Sargent Co., of Chicago.

DESIGNS FOR STANDARD 60-FT. CENTER-BEARING LOCOMOTIVE TURNTABLE.

By C. L. Strobel, M. Am. Soc. C. E.*

The illustrations show recent turntables built from designs of the writer which are different from the usual type in that no trailing wheels are used, and also in the manner in which the load is supported at the center. A nest of cone rollers is used, held in their relative position by a spider, so that displacement cannot occur, corresponding to the well-known Piper center (Eng. News, April 5, 1897), which has given such excellent service in the past. Instead of supporting the table at two points at right angles to the center line of the table and depending upon the support of the trailing wheels for any excess load tending to tilt the table, the table in this design is supported at four points forming a square 24 ins. each way. These four points support the table both transversely and longitudinally. The locomotive must, of course, be centered on the table, that is, its center of gravity must be approximately over the center of the table. For this condition the table is in balance and rotates upon the rollers with sufficient steadiness to require no assistance from the trailing wheels.

The tilting motion to which the table is subjected as the engine moves on, is permitted by this manner of support. This motion takes place around the two points of support nearest to the side from which the locomotive moves onto the table. The roller circle has an outer diameter of 3 ft. 6 ins., so that, even if the table is tilted, the load coming upon the rollers is well distributed and an overloading does not occur.

The first turntables of this type were built in 1894. At that time the distance between supports longitudinally was taken at 15 ins., and the tables built with these proportions gave entire satisfaction. The present center has been made larger than the first centers used, in order to accommodate the heavier locomotives which have since come into use, and the distance between supports longitudinally has been made 24 ins., as stated, instead of 15 ins. The rollers now used are of steel 8 ins. long, with 7 ins. outside diameter and 4½ ins. inside diameter. There are twelve rollers, making 96 lin. ins. of bearing, which is more than double what has heretofore been provided for Piper centers.

The bearing surfaces which press against these rollers are solid castings turned in a lathe and polished. Only the very small resistance of rolling friction under most favorable conditions, and acting with a small leverage is presented. The moving parts are run in oil and are thoroughly protected against dirt.

Turntables capable of accommodating modern locomotives must be designed on other lines than those which were suitable for the light locomotives in use ten or twenty years ago. As illustrating the increase in the weight of locomotives which has taken place, it is interesting to note that the bridges built on the Cincinnati Southern Ry. in 1874 to 1879 were proportioned for an engine weighing, with loaded tender, 66 tons, and for a freight train load of 1,800 lbs. per lin. ft. At the present time the freight train load called for in certain bridge specifications is as high as 5,000 lbs. per lin. ft., and a locomotive is in actual use, the Mastodon locomotive of the Great Northern Ry., weighing 154 tons, and having a length over all of 64 ft. Here is an increase in less than 20 years about as 1 to 2½.

The 154-ton engine of the Great Northern Ry. produces an end reaction while it is over one-half of the table of 70,000 lbs. maximum per girder. An ordinary consolidation engine, weighing with loaded tender 106 tons, will produce an end reaction of 46,000 lbs. maximum per girder. These loads are three and two times as great respectively as the maximum load upon a locomotive driver, and are far greater than can safely be put upon the trailing wheels of a turntable, no matter what their construction, especially when it is considered that each wheel in rolling upon the table drops down upon it about 1 in. and exerts a heavy blow in so doing. From these premises the conclusion was reached that modern turntables should be constructed without trailing wheels.

Having adopted this type of table it was found that many advantages would result therefrom. It hand power should not require more than two men, and it has been found that for the tables which have been built on the design here described, one man is sufficient for the turning.

For a table of this description (without trailing wheels) it is necessary to place the locomotive so that its center of gravity will be approximately over the center of the table. This should be done for any table, inasmuch as the friction arising from a load upon the trailing wheels acting with so large a leverage would make it very difficult to turn the table.

From an investigation made by figuring the center of gravity for locomotives both with empty and with loaded tender, it has been found that all locomotives of usual weight and proportions can be accurately centered upon a turntable of 60 ft. length. For the present turntable it would still be possible to operate it if the center of gravity of the locomotive was kept within a distance of 1 ft. either way from the center of table. It is, however, desirable to make the lengths of new turntables 65 or 66 ft., which has now become the

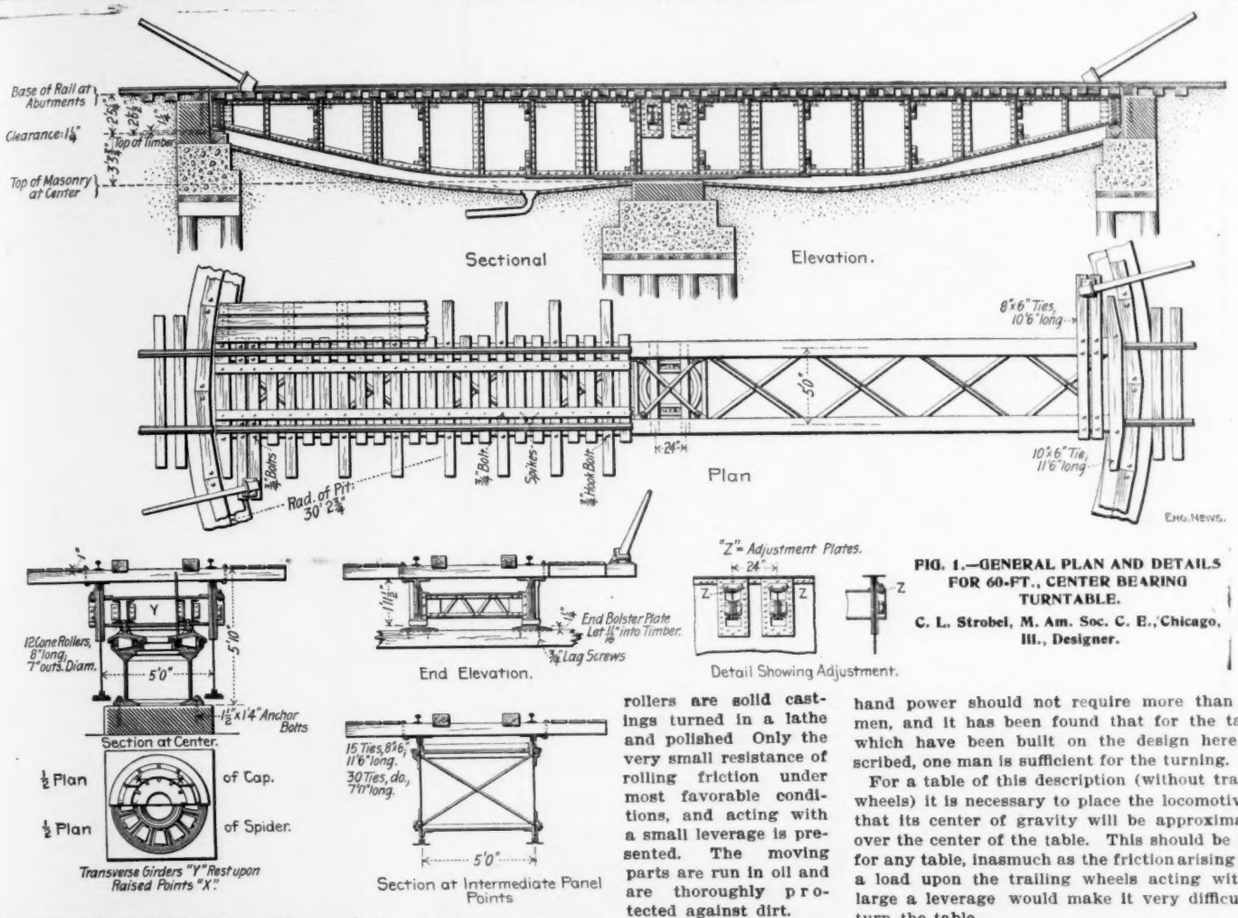


FIG. 1.—GENERAL PLAN AND DETAILS FOR 60-FT., CENTER BEARING TURNTABLE.

C. L. Strobel, M. Am. Soc. C. E., Chicago, Ill., Designer.

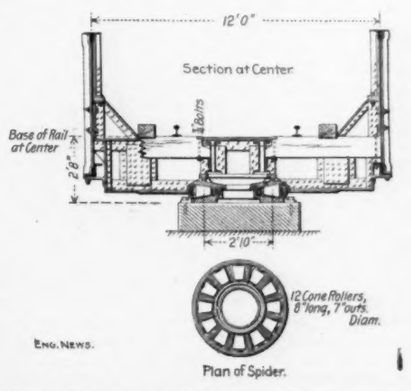


Fig. 2.—Transverse Section Showing Center Bearing for Through Turntable.

*Room 1744 Monadnock Block, Chicago, Ill.

standard on certain leading railroads. A 65-ft. table would be required for the 154-ton Great Northern Ry. locomotive, and on many roads it is desired to use a table not only for turning locomotives, but also for turning certain passenger cars, and that is another argument in favor of the longer table.

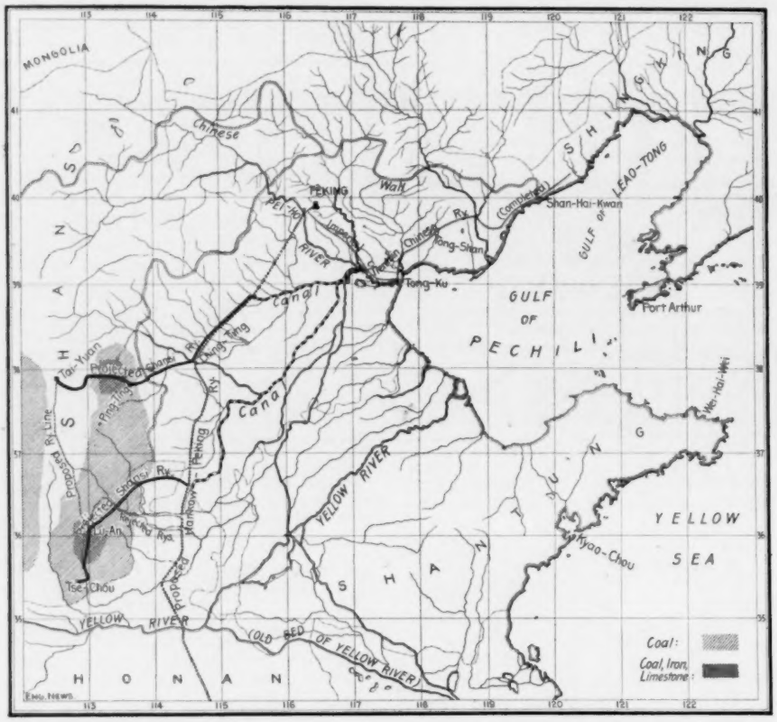


FIG. 1.—MAP SHOWING PROVINCES OF CHILI, SHANSI AND SHANTUNG, CHINA, WITH THE PROPOSED SHANSI RAILWAYS, AND THEIR CONNECTING LINES, EXISTING AND PROPOSED.

Instead of the circular rail usually provided for turntables with trailing wheels, this table is provided with bolster plates of ample size and strength to distribute the pressure over the wooden sills supporting them. These plates are used only at those points in the circumference where a support is required, which would be opposite to each track of the roundhouse. A set of four plates is needed for every track. If the turntable is to accommodate only two or three tracks the circular wall need not be made continuous, thereby saving considerable expense. The space between bolster plates and underside of turntable girders is made about ¼-in. greater than sufficient to allow for the deflection of the girders under maximum load. With the heaviest engine on the table it is intended that there shall be a ¼-in. clearance as the girders pass over the plates, but between the plates there is, of course, much greater distance. The plates are chamfered, so that, if the girders should accidentally scrape them, the motion of the table will not be arrested. These turntables are adjusted at the four ends of the transverse girders at the center by means of inserting one or more adjustment plates. It was thought desirable to avoid the use of adjustment screws, as these are almost invariably tampered with by unauthorized individuals. The possibility of raising or lowering each end of the two main girders is an important advantage for any turntable, and is an essential one for the proper operating of a through table. Once properly set up the table requires no further attention.

Among the important advantages of this type of turntable may be mentioned that the depth of pit at the outer circumference is small, thereby securing considerable economy as compared with turntables having trailing wheels, by the smaller quantity of masonry and excavation for pit required. The expense of keeping the pit clear of snow in the winter is also lessened. By making the girders for the 65-ft. table somewhat shallower at the end than for the 60-ft. table, which is done by simply continuing the slope of the lower flange as used for the 60-ft. table, the quantity of masonry required for the 65-ft. table is no larger than that required for the 60-ft. table, and the difference in cost of the two tables is therefore very slight.

THE PROPOSED RAILWAYS OF SHANSI, CHINA.

We are indebted to a special correspondent of this journal, who is now engaged in engineering work in China, for the material here used relating to the proposed railways in the Province of Shansi, China. As shown by the accompanying map, the carrying out of this project cannot fail to have a marked effect upon the material welfare of China, and, perhaps, upon regions outside of China, in the industries developed. The railways to be built would connect Peking and the coast line with what is claimed to be one of the richest and most extensive deposits of coal and iron in the world.

As to the natural conditions to be encountered, the Province of Chili, from Peking south, is a vast, alluvial plain, traversed by some of the many navigable outlets of the Yellow River and by canals. Just west of this Province is Shansi, with an area equal to that of England, Scotland and Wales. Its greatest length is north and south, and it is shut in on all sides by mountain ranges, the passes to the east showing elevations of 4,000 to 5,000 ft. above sea-level. The interior of Shansi is a plateau, with a general elevation ranging from 2,500 to 3,500 ft. above the sea. The eastern slopes of these mountains are bold and rugged and of granite formation. The western slope is more gentle and is chiefly made up of the famous "loess" formation of which much has been written. The location and construction of a railway through this formation will necessitate new methods of treating old construction problems, and the photographs here reproduced give some idea of the irregularity of the surface.

The two railways upon which construction will soon be commenced by the Chinese government are as follows: (1). The Tai-Yuan-Fu line, through Ping-ting to Ching-ting-fu, a distance of 175 miles. (2). The Tse-Chow line, through Luan-Fu, She, Wu-an to Han-Tang, a distance of 190 miles. The preliminary surveys for these lines were made in 1896 by an American engineer, and the actual work of construction is to begin in April, of this year, according to the plans mentioned some months ago.

From a Chinese point of view this section of China presents insurmountable difficulties to railway construction; and when the engineer sent out reported that construction was feasible upon both lines, and that the cost would not be excessive, he was regarded by the Chinese officials as one either lacking intelligence or veracity. On the northern line there will be some rock-work, a maximum gradient of about 1.25%, and one short tunnel. The peculiar features of this line lie in the 70 miles west from Ping-ting, through the loess formation. This division will demand the most careful and detailed study in location; but with this work well done, the cost of construction should be moderate.

The loess here met with is a mixture of clay and sand. Its characteristic feature is a vertical cleavage; and its consistency is such that when scoured out in ravines the walls are often several hundred feet high, and almost vertical. It overspreads everything where it occurs; and the chief difficulty presented to railway location and construction is the great number of unexpected ravines, running in every conceivable direction. In an otherwise flat country the engineer encounters ravines 400 ft. deep and 1,000 ft. across, with nearly perpendicular walls.

In this province the country roads are sunken much below the general surface, sometimes 50 ft. or more; and in riding along these roads the traveler can see nothing but the bare earthen walls on each side. But when an opening in this wall suddenly appears on one side, he finds that the bank is often only 10 to 15 ft. thick, and beyond that is a sheer drop of some hundreds of feet into a parallel ravine. In fact, the road is only a notch, cut by wind and rain into the side of a ravine, with a most unreliable parapet. After heavy rains

Fig. 2.—Terraced Farms in Shansi, Showing Chinese Village in Foreground.

these roads frequently disappear and a new one has to be found or made. This feature is of especial interest to the railway engineer, as the difficulty and expense of moving a roadbed has to be carefully considered, and guarded against where possible.

The topographical contour of all this country has been changed radically by the Chinese method

of farming. Every available foot of land is cultivated; and where the natural slope of the land is too great the surface has been terraced. Every hill is thus treated from top to bottom; and where necessary the sides of the terraces have been plastered with mud. In the dry season, there is no water in the ravines, and these areas are also cultivated at that time. The Chinese may be said to be the poorest farmers in the world; but they are among the best gardeners.

In all railway construction in China the economical crossing of the large rivers is a serious problem for solution. As long as the river is in the mountain region, with well-defined banks, the requirements are obvious and admit of but one treatment. But when that same river reaches the alluvial plain the problem becomes very complicated; and all of the many possible solutions are expensive, and there is a strong chance that the one selected may fail. During the "dry season" the river is, perhaps, only 300 to 400 ft. wide and a few feet deep; a ford, a temporary bridge, or a ferry, is sufficient for the needs of Chinese highway traffic. During the "rainy season" the same river is probably three to four miles wide and 15 to 20 ft. deep. For bridge construction there is no suitable timber available nearer than Oregon, in the United States. The cost of masonry and steel construction across the maximum width of the river is almost prohibitive, especially in the early stages of railway development in China.

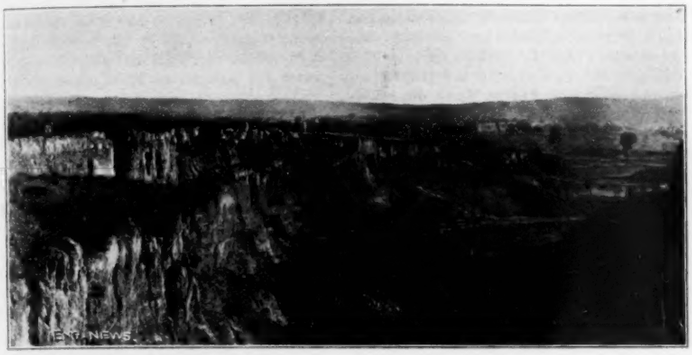


FIG. 3. BANKS OF A RAVINE IN LOESS FORMATION.

As the river only covers the wider bed for a few days in each year, and is confined to its proper channel for the rest of the time, the following expedient is to be tried in the construction of these Shansi railways: The embankment will be built in the river-bed as on the dry land; but it will be only a few feet in height, with very flat slopes on both sides, and these slopes well paved. The channel bridge will be at the same height as the embankment, and when the flood comes it will pass over both bridge and embankment, and traffic will be stopped. It is deemed better economy to stop operations for a few days in each year than to bridge the miles of river-bed at the height demanded for flood clearance.

On the line of the southern Shansi railway there is very little loess; and the line crosses three distinct mountain ranges almost at right angles to the axes. But notwithstanding the mountains, the country is "consistent" in its topographical features and there is no difficulty in finding an economical line.

Both of these lines follow the present main routes of traffic; pass near all the important towns and cities, and both terminate in an alluvial plain of Chili at a junction with the proposed Peking-Hankow-Canton Railway, the trunk-line of China. In addition to this connection, both roads abut upon navigable waters, which give direct water communication with the sea, by way of Tientsin. This gives the proposed line a very independent position.

The western terminals of these lines are in the two great coal and iron centers of Shansi, and the primary object of their construction is to furnish an outlet for these minerals, or their products. Moreover, there is an existing traffic with the coast sufficient in itself to yield a fair return upon the cost of the undertaking. As to the extent of the mineral deposits, it may be said that the engineer who made the preliminary railway surveys, inspected one unbroken coal bed, 200 miles long and 30 miles wide. This coal was from 25 ft. to 50 ft. thick, and of a most superior quality. Every village and hamlet had its own coal mine, or mines. The vein has just sufficient dip to carry off the water, and the area then examined did not cover half the known coal lands of this province. From Ping-ting north, and from Luan-Fu south, there are large areas of iron ore of a wonderfully pure mixture of brown hematite and spathic iron. This ore exists in apparently unlimited quantities, and in both districts good limestone is abundant. The right to develop this cheap center of iron and steel production has been acquired in perpetuity by an English syndicate, in which much American capital is invested. To connect these now inaccessible mines with the outside world, would warrant almost any expenditure in railway construction.

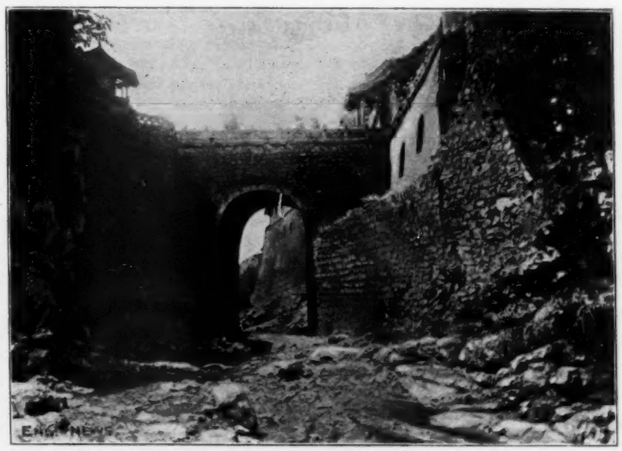
THE INFLUENCE OF WIDTH OF TIRE ON DRAFT OF WAGONS.

The University of the State of Missouri has recently published the results of an extended series of experiments to determine the influence of the width of tire upon the draft of wagons. The tests were conducted with 1½-in. and 6-in. tires on dirt, gravel and macadam roads, and on plowed fields, meadows and farm pastures, under various surface conditions. This work was commenced in January, 1896, and continued without interruption until September, 1897. The instrument used in recording traction was a Giddings self-recording dynamometer, registering a maximum strain of 3,000 lbs., and reading approximately to 5 lbs. In computing results, the mean height of the dynamometer autograph above the zero-line was determined by dividing the area of the section, as found by a planimeter, by its length. The narrow wheels had a standard tire, 1½-in wide. The wide-tired wheels were metallic throughout, of the same height, and made to fit the spindles of the narrow-tired wagon; many trials being made by simply changing the wheels. In all cases the same net load of 2,000 lbs. was hauled; the heavier weight of the 6-in. wheel being considered. The minimum length of run was 200 ft. and return; while this was often 400 to 600 ft. To neutralize the difference in level, the draft of the round trip was averaged, making the reported draft theoretically that of a level road. The speed of the teams was carefully made uniform at about 2½ miles per hour. The experiments were directly in charge of Prof. C. M. Conner, to March, 1897, and were then completed by Mr. D. W. May.

On a macadam street, hard, smooth, nearly level and comparatively free from dust, loose stone, or sand, the results of an August and a September trial were as follows: Contrary to expectations the broad tire pulled the lighter on the hard, smooth and inelastic road surface of 400 ft. in length. The difference in favor of the broad tires was 35.7% in one trial, and 16.3% in the other; an average of 26%. In other words, the draft required to haul 2,000 lbs. on narrow-tired wheels would have hauled 2,518 lbs. on the broad tires, as an average of the two trials.

The next test was on gravel roads, under six conditions of surface. In four out of the six the draft was much less with the wide tires; and in two cases they were practically the same. The conditions of surface for the 400-ft. run were as follows: (a) Hard, dry and no ruts; (b) same, with a few loose stones; (c) dry and free from ruts, but much sand in the gravel which prevented it from packing; (d) new road, reasonably dry and firm, no ruts; (e) water standing on surface, loose sand from 1 to 2½ ins. deep; (f) water standing on surface, 1 in. loose sand and gravel forming a slush, underlaid by hard road bed. In this last case the narrow tire gave 4% better results than the broad, as the slush had to be pushed aside; and more effort was required to push away or break down a ridge 6 ins. wide than one 1½ ins. wide. As an average of the six trials, however, the broad tire would have hauled 2,482 lbs., against 2,000 lbs. for the narrow tire.

Nine sets of tests were made over dirt and clay roads; varying in surface condition from smooth, hard and dustless to deep and stiff mud, just beginning to dry on the surface, and to dry on top and spongy beneath, and with different depths of dust. Under these conditions the maximum advantage of the broad tire was found when the surface was dry enough to allow the 6-in. tires to pass over without cutting a rut, but not stiff enough to prevent the narrow tire from sinking through. Under these conditions the advantage for the broad over the narrow tire ranged from 52 to 61%. But on a clay road, muddy and sticky on the surface, and firm underneath, the results were uniformly unfavorable to the broad tires. Two or three inches of dust was also unfavorable to the broad



F.G. 4.—MASONRY ARCH BRIDGE IN A CHINESE VILLAGE.

tire. As the mud becomes softer and deeper the difference between the draft of the two types of tires rapidly diminishes, until the condition is reached where the mud adheres to both sets of wheels; here, the advantage of the broad tire ceases entirely, and the narrow tire pull is materially lighter.

In the case of deep ruts on a clay road with dry surface, the first run of the broad tire over the narrow tire ruts shows an increase of draft over the narrow tire running in its own rut. But the second run over ruts not too deep shows advantage for the broader tire; and with ruts 8 ins. deep, and with hard walls and bottom, three runs of the broad tire have been sufficient to so improve the road surface that both the broad and narrow tires passed over it with less draft than the narrow tires required in the original ruts.

In summing up the experiments those engaged in them found that on dirt roads there were but three conditions on which the broad tire pulled heavier than the narrow one. These are: (1) When the road is sloppy, muddy or sticky on the surface and hard beneath; (2) when the surface is covered with very deep, loose dust and is hard beneath; (3) when the mud is deep enough to adhere to both types of wheels. These are unusual conditions, of comparatively short duration. Tests made on meadows, pastures, stubble land, corn land and plowed ground, both dry and hard and wet and soft, showed a difference in favor of the broad tire ranging from 17 to 120%.

One of the serious objections to the adoption of the broad tire is the necessity of running over deep ruts made by narrow tires, after the walls of these ruts become dry and hard and the rest of the road surface is smooth. The experimenters, for this reason, made extended tests in this direction. They found that the 6-in. tires almost completely filled the narrow tire ruts in four round trips over the road; and after the first run of the broad tires over deep ruts, and with half the wagons still using the narrow tire, the user of the broad tire will be enabled to haul a given load with considerably less draft than the user of the narrow tire. In other words, every run of the broad tire is a benefit, and every run with the narrow tire is an injury. The report shows photographs of sections of ruts made by the two types of tires; these being made possible by filling the ruts with plaster-of-Paris. On soft stubble land, with equal loads, the depths of the two ruts are as 14 is to 5 ins.; and on corn land, just dry enough to plow, the depths are 9.5 and 2.7 ins.

For a combination farm and road wagon a 6-in. tire is believed to be the most satisfactory, all things considered. The 3 and 4-in. tires are unsatisfactory in permitting them to sink some distance into the ruts made by the narrow 1½-in. tire, and the side friction is thus largely increased. Experiment shows that the 6-in. tire is always better for farm use; and on the road there are but two cases where the 4-in. would show a lighter draft than the 6-in. tire; that is, when the surface is soft and sticky with hard material beneath, and when the mud is deep and stiff enough to adhere to the wheels. As to the comparative lengths of the front and rear axles, while a difference in these lengths would make the wagon a better road-roller, and be thus beneficial to the road, this arrangement would also greatly increase the draft; unless the large majority of wagons were so made and the general road conditions were very much improved. Axles of equal length are to be preferred, say the University experimenters; and this is especially so with farm wagons, both because less traction is required and for greater facility in turning. As it is, a 6-in. tire will strike the wagon-body quicker, in turning, than the narrow tire; and if the distance between the rim of the wheel and the wagon-bed be further reduced, the difficulty of turning would be increased still further.

NOTES FROM AMERICAN BRIDGE SHOPS.

III.

Phoenix Bridge Co., Phoenixville, Pa.—The buildings of this plant are located on both sides of French Creek, a small stream emptying into the Schuylkill River, and when, in 1790, the original rolling mill and nail factory were started, the power for driving them was obtained by damming this stream. This dam is still in existence and the power stored by it is still used, though modern turbines have taken the place of the old-time water wheels. In these early days the plant was known as the French Creek Works, later as the Phoenix Works, and finally as the Phoenix Iron Co., the name which it now bears. The work of the company in originating and using the Phoenix column is familiar history to engineers, and it deserves mention no less for first starting the manufacture of wrought iron eye-bars and pushing their use in American bridge building. In bridge work the Phoenix column has long since gone out of general use, but the eye-bar has survived the change from wrought iron to steel in bridges and has gained increased usefulness in the transition.

Altogether the works comprise some 30 buildings, the steel plant and the bridge works having separate shops, except for processes common to both, and, of course, separate organizations in both the office and shop forces. In many respects the bridge works have one of the most complete drafting-room systems known to the writer among bridge works. It is based upon the principle of having some one man personally responsible for every drawing made. To attain this end the draftsmen are divided into five groups of approximately the same number of men each. At the head of each group is an assistant engineer, who is held responsible for the correctness of every drawing turned out by the men under him. A piece of work, upon coming to the drafting-room from the estimating and designing departments first reaches the chief draftsman, who turns it over to one of the assistant engineers, or, perhaps, if the job be a large one, divides it and gives a separate part to each of two or more assistant eigineers. The assistant engineers then assume charge of the work, dividing it up among their draftsmen as they may think best. When the drawings are finished they are checked and approved by the assistant engineers, and then passed up to the Chief Draftsman, and finally to the Chief Engineer for examination and approval. The drawings then take their usual course through the shops in the form of blue prints, and finally, when the work is finished, are indexed and filed.

Each drawing is made on a standard sheet, 23 × 41 ins., and most of the draftsmen are trained to make the original pencil drawing on the tracing linen, which is afterwards inked in, instead of tracing them from pencil originals made on paper. The rough side of the linen has, of course, to be used for this pencil work. When a contract is completed the sheets of tracings belonging to it are fastened together at their left-hand edges and filed flat in cases of drawers built in a fire-proof vault. These sets of drawings are numbered from 1 to 1,000, and as many are filed in a single drawer as it will comfortably hold, an appropriate legend being pasted on the front of each drawer to show what it contains. The drawings are, of course, filed in chronological order.

For ordering material the office has a number of forms of order sheets with the proper ruling and printed headings, which are filled in in duplicate and distributed to the proper departments. For example, there are order sheets for castings, built members, eye-bars and upset rods, pins and nuts, etc. The rulings and printed headings differ, of course, in each of these forms, but generally they always give for each piece the individual mark, number of pieces, general description, general dimensions, finish, drawing number, number of shippers' pieces, and general mark. A set of these sheets bound together form the "order book" for each contract, which is filed as a permanent record.

The bridge shops proper of the company comprise a truss shop, machine shop, boring shop, forge shop and annealing furnace, a physical testing laboratory and other buildings. In the testing laboratory, as many of our readers know, is installed the 1,080-ton, hydraulic testing machine for breaking full-size members (Eng. News, Jan. 10, 1891). The recent work of this machine in breaking cast-iron columns for the New York Building Department has been described in Engineering News of Jan. 13 and 20, 1898, and at the time of the writer's visit the machine was still surrounded by the fragments of broken columns. This machine has broken by tension eye-bars of 12 × 3 ins. section, and the forge shops of the company are equipped to make these large bars and, of course, all smaller sizes.

In its general arrangement the truss shop of this company differs from that of any other shop which the writer has seen. The building is oblong in plan and is cut by two transepts, each of which is covered by an electric bridge crane. The plates and shapes enter the east end of the building on narrow gage cars, and are laid out, punched and drilled. They are then taken upon the push cars to the first transept 180 × 70 ft., where they are lifted from the cars by the bridge crane and delivered to the skids for assembling. As soon as its parts are assembled each piece is carried by the traveling crane to a car on such a track as will take it direct to the especial riveter which is to do the work upon it. In the second transept are located the finishing tools for milling, boring and facing the built-up members. From this transept push cars again carry the finished members to the west end of the shop where they are inspected, painted and loaded on cars for shipment by a third crane.

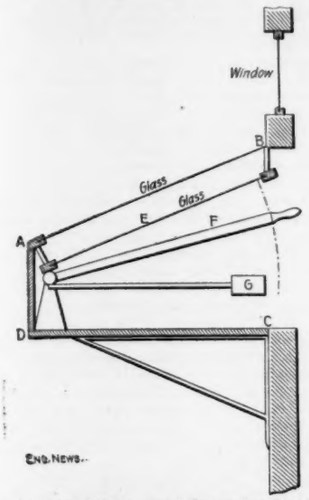
Ths truss shop, and, in fact, the whole bridge works were doing little at the time of the writer's visit, but in the loading yard was piled the completed steelwork of the new St. Lawrence River Bridge at Cornwall, N. Y., for which the foundations are now under construction by Sooysmith & Co., of New York. This is a double structure, there being two channels to the St. Lawrence at this point. Across the North Channel the structure is of the cantilever type, having a channel span of 420 ft., made up of two cantilever arms, each 131 ft. 3 ins. long, and a suspended span of 157 ft. 6 ins., and two shore spans of 210 ft. 6 ins. The structure over the South Channel consists of three Pratt truss spans of 368 ft. ½-in. c. to c. of end pins. In conclusion it may be noted for the benefit of those who may be curious as to the amount of steelwork in the towers and shore spans of the New East River Bridge (Eng. News, Feb. 17, 1898), that the estimating department, which had just finished an estimate upon which to base the company's bid calculated it to be between 12,000 and 13,000 tons.

Edge Moor Bridge Works, Edge Moor, Del.—The works of this company are located upon the Delaware River, about 24 miles from Philadelphia, and comprise a complete bridge plant, including an eye-bar plant, and also a boiler shop. If the writer is not mistaken, these works were the first to install a plant for manufacturing steel eye-bars by upsetting the ends and annealing, the universal process for forging steel eye-bars, which, of course, cannot be welded. At present eye-bars of 3 × 10 ins. section are made, and one of the accessories of the works is a 350-ton hydraulic testing machine capable of taking in bars 35 ft. long, and about 1½ × 6 ins. section.

The movement of material in the truss shop is by push cars, and overhead trolleys and jib cranes. For punching and reaming the equipment of tools is very complete. Besides single punches there are two Sellers' multiple punches, one capable of taking in a plate 62 ins. wide, and the other for punching angles. The reamer plant consists of nine radial reamers placed in a row and so arranged that all the holes can be reamed in a girder 131 ft. long and 15 ft. deep without shifting the work. A recent tool which has been installed is a planer for planing the bevel track for swing bridge turntable drums. This is simply a circular drum 38 ft. in diameter, pivoted at the center and having wheels at the periphery much like a swing bridge drum. An extension of the pivot above the drum serves as the inner post of a tool arm, the outer post of which is erected outside of the drum. The tool arm is capable of being adjusted vertically at any height on these posts, while the tool head slides on the arm and can also be adjusted to any angle so as to vary the bevel of the planer cut. The method of operation is simply to adjust the turntable drum on the table, adjust the tool arm, and put the table in revolution by means of the mechanism provided for the purpose, the tool being stationary.

The drafting-room practice of these works has

recently been described by Mr. Charles H. Wright, Chief of the Drafting Department, in his book on "Bridge Drafting," far better than can be done in the limited space at the writer's command, and it will not be mentioned further here. In the blue print room, however, the writer observed an arrangement of the blue printing frames which he had never seen before, and which may also be unfamiliar to some of the readers of Engineering News. Instead of the more common sliding frame, which is run in and out of a window, this firm has designed the special window shown by the accompanying sketch, drawn from memory. The window A, B, C, D, projecting from the side of the building, contains the fixed glass E, and the movable frame F, counterweighted by the arm and



Sketch of Special Window and Frame for Blue Printing. Edge Moor Bridge Works, Wilmington, Del.

weight G. The frame F is covered by a bed of cotton wool held in place by a square of ordinary carpeting, and closes up tight against the glass E. The sensitive paper and tracing are simply placed in the proper position on the frame, which is closed up against the glass for printing and lowered for inserting and removing the paper and prints. As all drawings are made upon sheets 26½ × 35½ ins., the frame F is made just large enough to hold these sheets. The blue print room has a number of these windows and available space for more should they be needed.

Some idea of the important item which blue printing becomes in a large bridge works is obtained from the statement of Mr. Wright that the average daily production of blue prints at the Edge Moor works is 175 sheets. About eleven prints are made of every tracing, nine of which go into the shops for use in geting out the templates and steel work.

In the loading yard a traveling bridge crane for loading finished material was noticed, which was of unusual size. The trestles along which it moved were fully ⅛-mile long, and the crane had a span of 75 ft. Both the push car tracks from the shops and the switch tracks from the railway run under the crane, and material is transferred from one to the other very rapidly. The great length of the trestle also enables material which is ready to ship to be stored temporarily within direct reach of the loading crane. The principal work which the company had in hand at the time of the writer's visit was the steel work for the Willis Ave. bridge across the Harlem River, in New York city (Eng. News, Sept. 23, 1897), and this had not got much beyond the template shop.

Pennsylvania Steel Co., Steelton, Pa.—As the readers of Engineering News probably know, the bridge and structural works are only one department of this firm's activity. Steel is produced here by both the Bessemer and open hearth processes, and is rolled, cast and forged into various commercial forms, such as bridge pins and shafting, castings for switch and signal work, street and steam railway rails, and structural shapes of all kinds. At the time of the writer's visit the steel plant and switch and signal works were very busy, but the structural works only fairly so, and mostly on small contracts.

In laying out the structural shops here the engineers were very much circumscribed, both by the area and shape of the land at their disposal. The plan adopted was to place the truss shop in the angle between the arms of an L-shaped yard. Material enters the yard at the extreme end of the longer arm of the L and is carried by a bridge crane the full length of this arm. Another bridge crane covering the short arm of the L then takes the material to the extreme outer end of this arm, where it is deposited onto push cars and taken into the shop at the side farthest from the long arm of the L. The material then works across the shop to the finishing tools, from which it is loaded onto push cars, run out of the shop underneath the smaller bridge crane, which in turn takes it to the extreme end of the long arm of the L, where it is loaded for shipment at the same point at which it was delivered in the rough shape to the yard. The short arm of the L, and that portion of the long arm opposite the truss shop are roofed over, and here most of the laying out, edge planing and shearing are done. The punching, assembling, reaming, riveting and finishing are done in the truss shop proper, the tools being arranged in the order named and in longitudinal rows, so that the movement of the work is transversely across the shop.

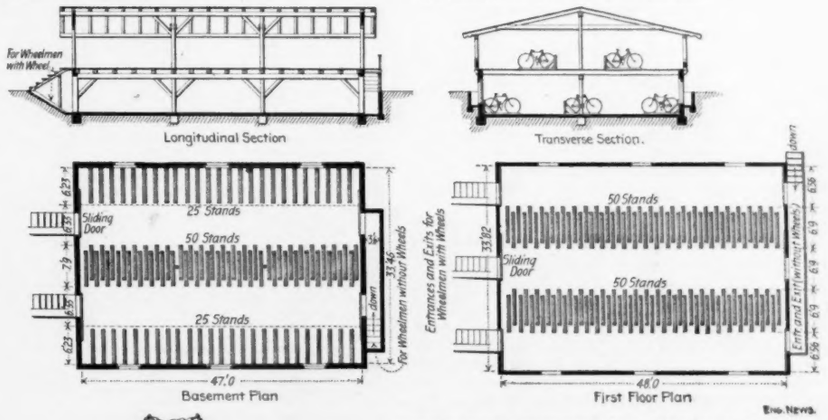
In general the tools are of modern makes, but most of them call for no especial mention. Among them, however, was noticed a double-boring machine capable of taking in members 50 ft. long, and boring both pin holes at the same time. This machine was built by Bement, Miles & Co., and is described and illustrated elsewhere in this issue.

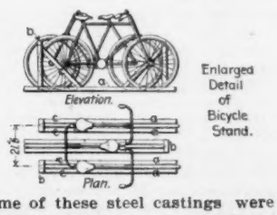
In the switch and signal department one was impressed most, perhaps, with the really handsome steel castings turned out for some of the special frog and crossing work. To one brought up in the traditions of the cast-iron foundry, with its bogys of shrinkage, crystalization, etc., the complicated shapes and abrupt variations in thickness of some of these steel castings were something of a shock. Another point of interest which the visit to this department brought out, was the fact that all these special frogs and crossings are laid out to mathematical lines and carefully assembled and fitted prior to delivery. The layout shop is a large open building, having a floor of ordinary cedar block paving to which the rails are temporarily spiked in exactly the positions they are to occupy in the actual installation. At the time of the writer's visit several of these "layouts" were in progress, one being the crossing of a double track steam railway and a double track cable railway, with slot rails and everything complete.

A PRIZE PLAN FOR A BICYCLE STORAGE HOUSE.

The storage of bicycles in such manner as to occupy the least space and still enable the owners of wheels to quickly place and remove them without interfering with one another is a problem which is of practical interest to many owners of factories, as well as to railway officers who have to provide bicycle storage rooms at stations. In a letter published in our issue of Nov. 18, mention was made of the fact that the Prussian "Ingenieu und Architekten Verein" (the "Am. Soc. C. E.," of Prussia), had offered a prize for the best design for a bicycle shed, in answer to the demand of a manufacturer who had some 200 employes who used wheels in going to and from work. Those taking part in the competition were instructed to design a low building, occupying a minimum area and having a storage capacity for 200 bicycles; these latter to be so stored that they could be put into place and removed again with the least confusion and loss of time on the part of the workmen. Our correspondent, "2 Wall St." who referred to this competition has made good his promise to send the plan which received the prize, and we reproduce it herewith for the benefit of our readers.

As seen by the drawings, two parallel floor strips a, end posts b, and two inclined struts c, keep each bicycle in place; and these racks are so spaced as to take up the least room on the floor. The separate passageways, each with its own entrance door for wheelmen, permit access to the racks without confusion; and separate exits at the opposite end of the building further facilitate this ease of movement. It will be noted that the entrances are provided with steps for the men with an incline at the side for the bicycles. The exits have a common platform with but one stairway. The plan calls for a two-storied structure, with 100 wheels on each floor. The difference in the floor arrangement of the racks is made to facilitate the location of the entrances; three stairways giving access to the upper floor and two stairways, placed between the others, descending to the basement floor. The successful competitor was Mr. Carl Bernhard, engineer and architect.





A DESIGN FOR A BICYCLE STORAGE HOUSE OF 200 WHEELS CAPACITY.

(Awarded First Prize in a Competition Instituted by the Prussian Society of Engineers and Architects.)

This plan should be valuable to some of our railway companies as suggesting what would be a very useful adjunct to many suburban stations. A storage shed of similar construction might be made a very paying venture on the boulevard and parks of any large city.

As noted in our news columns, an iron storage shed for bicycles has been designed for the use of the State, War and Navy Departments, at Washington, D. C. The clerks of these departments now use about one thousand bicycles, and these are at present stored in the corridors of the buildings, to the inconvenience of all concerned.

THE SMOKE NUISANCE is being discussed in the city councils of Atlanta, Ga. Mr. Pittmann, the Building Inspector, has been instructed to write to manufacturers of smoke consumers inviting them to come to Atlanta and make a practical demonstration of the operation of their devices.

THE WELSBACH LIGHT CO. has obtained a judgment in its favor against the Sunlight Incandescent Gas Lamp Co. for infringement of the Rawson patent. This patent covers the strengthening of the mantles to prevent breakage during transportation by coating it with paraffine or other suitable material. The Sunlight Co. used a collodion solution for strengthening the mantle, which Judge Townsend, of the U. S. Circuit Court, holds is included in the "other suitable material" of the Rawson patent, and its use therefore constitutes an infringement. It is said that this decision will give the Welsbach Co. a virtual monopoly of the manufacture and sale of mantles.

THE COST OF PIPE CULVERTS and the best manner of constructing them is being investigated by a special committee of the Association of Railway Superintendents of Bridges and Buildings. This committee requests from railway men and engineers such information as they may be able to give in answer to the following questions:

(1) Do you use, on the railway with which you are connected, any form of cast iron, wrought iron, steel, cement, vitrified or wooden pipe culverts? (2) If so, please send plans and specifications for the different kinds of culverts you use, stating the minimum and maximum sizes of each kind of pipe. (Members are requested to send tracings when practicable.) (3) If more than one kind of pipe culvert is used, please state the considerations which decide the use of a certain kind in a given case. (4) Are end walls built at one or both ends? If so, are they built of wood, stone or concrete? (5) If end walls are not built in all places, state considerations which decide their use in any given place. (6) Please describe in full your method of putting in the different kinds of pipe culverts: (a) When built to replace timber culverts; (b) When built to replace wooden bridges; (c) When built through a bank where there has been no previous opening. (7) Have you experienced any trouble from the breaking or flattening of pipe culverts, on account of the weight of the earth filling? (8) If so, what means have you adopted to overcome this difficulty? (9) Please give cost of pipe culverts of the kinds you use under the three different cases, dividing the cost, where possible, into the items of material and labor for the pipes and end walls. (10) Please give any other information on the subject, not covered by the above list of questions.

Answers to these questions should be sent to W. A. Rogers, Asst. Engr. Bridge & Building Department, Chicago, Milwaukee & St. Paul Ry., Chicago, Ill.

GOLD FROM SEA-WATER, and a gold extracting process by which more gold is got out of an ore than the assay shows it to contain, are both discussed in the "Engineering and Mining Journal" of March 26. It characterizes the project of the Electroiytic Marine Salts Co., at North Lubec, Me., which claims to be extracting gold from sea-water, as "simply another attempt to impose on the credulous," and the Marshall gold process, which its promoters claim has obtained $9.90 gold per ton from an ore that showed not a trace by fire assay, as a "fake process."

NOTES FROM THE ENGINEERING SCHOOLS.

Massachusetts Institute of Technology.—A large impact testing machine is being designed for the engineering laboratory for testing car axles and iron beams transversely under impact, and straight specimens in compression under impact. The machine is built something like a pile-driver with a hammer of 500 lbs. and a maximum drop of about 8 ft. The principal casting will weigh about 25,000 lbs.

A machine is also being designed for repeated stress in opposite directions, which will have a capacity of 100,000 lbs. The stress will be applied in tension and compression alternately at the rate of 60 turns per minute, accurate measurements being taken in the meantime by micrometer readings.

An interesting piece of thesis work is being done in this laboratory on the durability of different forms of brake shoes. An apparatus will be rigged by which pressure can be applied to the brakes while the wheels are revolving, so that the pressure can be accurately measured; and the apparatus will be run continuously for a number of days, and the wear of the wheel and shoe noted. It is estimated that with one set running at the speed of about 60 turns per minute about 75 HP. will be consumed.

A new friction brake for measuring and absorbing power up to 100 HP. has just been delivered by the Taunton Locomotive Works. It makes 200 revolutions per minute, and weighs about 5,000 lbs. The brake wheel is about 5 ft. in diameter, 15 ins. face, and has a coil of pipe embedded in the rim of the wheel within half an inch of the upper circumference. The water used for cooling the brake passes through this copper tube and out through a hollow shaft.

Lehigh University, South Bethlehem, Pa.—The engineering courses have been extended by the shifting of a part of the technical work into a Summer School, to be held at the close either of the Freshman or of the Sophomore year. In this Summer School instruction will be given in Topographic Surveying to students in the Civil and Mining Engineering courses, and in Mechanical Technology to students in Mechanical and Electrical Engineering courses. Optional courses will also be given in Land Surveying and in the examination and sketching of machine parts and of electrical apparatus and machinery.

Prof. W. S. Franklin, late of the Iowa State Agricultural College, has been appointed as head of the department of Physics and Electrical Engineering, in the place of Prof. Harding, who has retired, after 25 years of work, with the title of Emeritus Professor. The faculty and instructors now number in all 42, and the number of students enrolled is 363.

Cornell University.—Dr. R. H. Thurston, Director of Sibley College, the department of mechanical engineering of the University, has written the following letter in relation to the desire of the graduates of the college to enter the service of the U. S. Navy, and to their qualifications for such service. Dr. Thurston was a chief engineer in the Navy during the war of the Rebellion, and knows from practical experience what kind of men are needed in the Engineer Corps.

Ithaca, N. Y., March 18, 1898.

Commodore G. W. Melville, U. S. N., Chief of Bureau of Steam Engineering, U. S. Navy Department, Washington.

Sir: Should the need and the opportunity come, there are a number of young men about graduating from this institution, and probably many alumni, who will desire to enter the navy and do what they may to sustain the honor and the prestige of their country. In their behalf I desire to submit a statement of the case for such of them as may wish to enter the Engineer Corps, should the law permit.

All of these men have had an exceptionally complete and practically valuable preparation for success in that line of duty. They have had, during four years, a continuous and systematic, and remarkably fruitful course of instruction, training and practice in the workshops of this institution, in wood and iron-working, in iron and brass-founding, and in various branches of construction, including the building of steam engines, and other machinery. They have thus become exceptionally expert in the handling of tools and in their employment in practical work. They have, similarly, enjoyed the privilege of systematic instruction and of considerable practice, throughout their four-years' course, in the use of the draftsman's instruments and the work of the drawing room. They have been systematically, and with unusual thoroughness, taught the science and the practice of the art of machine design, and have had considerable experience in its applications in the design of heavy machinery, principally the steam engine.

In addition to these lines of technical and practical work, they have lived in the laboratories a considerable portion of the working day, for some years, including work in the chemical, the physical and the mechanical laboratories, and have learned, in addition to the usual and standard methods of the scientific departments, those practical applications which are most valuable to the mechanical engineer. They have, in the mechanical laboratory of the Department of Experimental Engineering, learned to test iron and steel and all the materials of engineering, to test lubricants, to take down and to assemble oil, gas and steam engines, and to operate them correctly. They have practiced extensively in the conduct of engine trials and boiler tests, are familiar with all the special apparatus of the engineer, and its use is entirely and perfectly satisfactory in their hands.

Every man of them has given sufficient time to the actual work of the shop and the drawing-room, and to the actual management of machinery, including engines and boilers, to be prepared to render valuable assistance, and to be of rare value in emergencies, after a little practice in his assigned position, wherever he may be sent, or with whatever duty, as a subordinate, he may be entrusted.

These young men desire the privilege of giving to the nation their services. Very truly yours,

R. H. Thurston.

State College of Kentucky, Lexington, Ky.—We have received the "Brief Announcement" of this college for 1897-98, from which we learn that its mechanical engineering department has an equipment and facilities "superior to anything in this line south of the Ohio River." A half-tone cut gives a view of "Mechanical Hall," showing it to be a large and handsome building. It contains three recitation rooms, two drawing rooms, a wood pattern shop, two boiler rooms, two machine shops, blacksmith shop, foundry, and two large rooms devoted to experimental engineering. Graduates of this department receive the degree of B. M. E. A post graduate course leads to the degree of M. E. Prof. F. Paul Anderson is at the head of the department.

BOOK REVIEWS.

DE PONTIBUS.—A Pocket-Book for Bridge Engineers. By J. A. L. Waddell, M. Am. Soc. C. E. New York: John Wiley & Sons; leather with flap; 4½ x 6¾ ins.; pp. 403; illustrated. $3.00.

"Concerning Bridges" is, on the whole, a rather appropriate title for this book, and it gives a much truer idea of its contents than does the sub-title. The reader may reasonably be pardoned, however, for asking why the Latin language was used instead of the equally good English. The author justifies this choice, with what wisdom we shall let our readers decide for themselves, in the following words:

For five consecutive years of his early life the author devoted more than half of his working time to the study of the Latin language; and this is the first opportunity which has occurred during the twenty-two years of his professional career to put the knowledge(?) so obtained to any practical use. Moreover, he fears that if he be so fortunate as to be able to practice his profession another twenty-two years, no other occasion will occur to use it, so he feels the necessity of grasping this unique opportunity of a lifetime.

The book is not a pocket-book in the sense that "Trautwine" and "Kent" are, except for its size and makeup. It is rather a combination of the author's personal opinions upon bridge designing, with rules and specifications of the author's own making for the guidance of bridge engineers in such work. Both these opinions and these specifications have been introduced to bridge engineers in part before, and engineers have not failed often to question their wisdom and truth. It can hardly be expected, therefore, that they will be accepted by every one without criticism now that they have been put in book form.

The fact remains, however, that Mr. Waddell, like every bridge engineer of long experience, has amassed a great deal of information regarding bridge designing in its relation to business considerations, shop practice and other practical constructive questions, which is exceedingly valuable to young engineers, but which these young men have little opportunity of knowing through most books. In putting this information into book form he has rendered a distinct service to the profession. The older men who have been through the mill may, perhaps, find less instruction, but even to them we think that the author's very definite and sometimes unusual views upon many questions will give a decided fillip to its reading.

The book is divided into 24 chapters, as follows: (1) Introduction, (2) First Principles of Designing, (3) True Economy of Design, (4) Æsthetics of Design, (5) Cantilever bridges, (6) Arches, (7) Trestles and Viaducts, (8) Elevated Railroads, (9) Movable Bridges in General, (10) Revolving Draw-Bridges, (11) Highway Bridges, (12) Combined Bridges, (13) Detailing, (14) General Specifications Governing the Designing of Steel Railroad Bridges and Viaducts, and the Superstructures of Elevated Railroads, (5) Specifications for Railroad Draw Spans, (16) General Specifications Governing the Designing of Steel Highway Bridges and Viaducts, (17) Specifications for Highway Draw Spans, (18) General Specifications Governing the Manufacture, Shipment and Erection of Steel Bridges, Trestles, Viaducts, and Elevated Railroads, (19) Compromise Standard of Live Loads, (20) Timber Trestles, (21) Inspection of Materials and Workmanship, (22) Designing of Piers, (23) Triangulation, (24) Office Practice.

It will be noted that stresses are not touched upon, the author referring his readers to the standard treatises upon this question, and also that the treatment of specifications is unusually full. These specifications, with the chapter upon First Principles, will, we think, be considered by many readers the most valuable in the book. The text proper of the book is followed by 28 tables and diagrams compiled to aid the designer in working up his details and various other calculations.

In form and typography the book is excellent, but the author has provided an index which is about as crude an attempt at indexing as has recently come to our notice. A few quotations will help to make the worst faults plain. "Assumed uplift for draw spans" is not cross indexed under "draw spans"; "Best kinds of paint" not under "paint"; "Character of flange section of plate girders" not under "plate girders"; "Diagram of reactions for draw span" not under "draw span"; "Exterior sidewalks" not under "sidewalks"; "Full length of section" not under "sections"; "General notes on detail drawings" not under "drawings"; "Insufficiency of rivets in elevated railroads" not under "rivets" or "elevated railroads"; and so on through the alphabet we find such headings as "Lack of regularity"; "Long steel tape"; "Making drawings"; "Necessity for symmetry"; "Objections to curved members"; "Placing concrete under water"; "Reasons for using medium steel"; "Study of aesthetics"; "Tops of trestle columns"; "Use of slide rule"; "Value of faculty of judgment"; "Work designed by author's specifications," etc., etc.

A defective index to an ordinary engineering treatise is always discreditable, but in a pocket book which is to be used entirely as a book of reference it is a constant source of annoyance to the person who consults it, and it is to be hoped that the author and publishers will at an early date provide this really valuable little manual with a properly compiled index.